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THE CYCLE OF LIFE
ACCORDING TO MODERN SCIENCE

BEING A SERIES OF ESSAYS DESIGNED TO
BRING SCIENCE HOME TO MEN'S
BUSINESS AND BOSOMS

BY

C. W. SALEEBY, M.D.

WITH DIAGRAMS BY
RICHARD MUIR

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THE CYCLE OF LIFE ACCORDING TO MODERN SCIENCE

GREAT BRITAIN'S NEED

UNTIL some far-distant day when, perhaps, we may establish friendly relations with the inhabitants of some other planet, and when, since there, too, will be evil and sorrow, our altruism must widen its embrace beyond the limits of the human family—till then, we can take no larger view than that of this planetary race and can demand no more from any human institution than that it be for the welfare of all mankind. One does not need to waste time in asserting that science is such an institution, for its claims to be so considered have been upheld long ago. It is already, though in its youth, a tower of strength, foursquare to many of the winds that assail humanity.

It is part of its boast that science knows no bounds of race or clime. And on this matter I must needs alienate from myself the sympathy of most of my readers—thus, perhaps, serving to dissipate the natural suspicion that I am about to advocate the claims of science because it is to my interest that these should be recognised. Science, as I have said, knows no bounds of race or clime; and if we divest ourselves of our very natural and, in a sense, laudable prejudices, we are bound to admit that this is as it should be. While practical charity should begin at home, yet, theoretically, perfect altruism should sympathise with any sentient being in strict proportion to its sentiency. Other things being equal, we should prefer to find the sorrows of a dozen relieved in Zanzibar or Moscow than of eleven in London or New York. I say, other things being equal, because it is conceivable that benefits conferred on a certain race may ultimately prove to be more valuable to humanity at large than benefits conferred on another race—and this point is essential to the argument of the present essay. If we come to look into the feeling of patriotism as we see it in ourselves, it may, perhaps, wear a different aspect to that which we generally conceive. To take a concrete instance: I have no personal friends in, let us say, Liverpool. The pleasures and pains of Liverpool, as they may be affected by the presence of plague, do not concern me personally more than the pleasures and pains of Canton under the same affliction. I should, therefore, be just as anxious to hear that the rat—which carries the plague—is being destroyed in Canton as in Liverpool. My patriotic preference for the latter city is not, therefore, specially creditable. It is, at bottom, egoistic rather than altruistic. I want the nation to which *I* belong to show its skill in such a matter, because it tends to *my* glory. You remember Carlyle's comment on a book of Thomson's poems borrowed from a public library. Opposite "Rule, Britannia," he scribbled, "Cock-a-doodle-doo." And most of our patriotism is, we may guess, thus a personal assertion made indirectly.

If we admit all this, it follows that to advocate the claims of science as our national need is not a proceeding strictly defensible from the absolute ethical stand-point, if our motive be merely Britain's glory and prosperity as such. From the disinterested point of view of a Martian, there may be no particular reason why Britain should be glorious and prosperous rather than Liberia or Uruguay. There are sentient beings in both, and their deserts, we may hazard, are much of a muchness. It is, indeed, entirely alien to the spirit of science itself—of science which has done so much and will yet do more to break down national barriers—that one should advocate its claims merely for the benefit of a particular people. Unless other considerations can be advanced, one should advocate its claims wherever science is most needed—and that is certainly not in Great Britain.

Recognising all this—which I fear is but feebly stated platitude—we have further to recognise that the existence of nations is itself a scientific fact—inconsistent with no other. And stripping ourselves both of patriotic and anti-patriotic bias—to quote Herbert Spencer—we are frankly fain to admit, as another fact in the science of history, that the share of what Carlyle called "this remarkable island" in the furtherance of human welfare has been signally and memorably great. True as this statement is in many of its applications, it is conspicuously true of science, in which our record is without a distant parallel. Thus we arrive at the following correlation of statements, the truth of which, I think, may fairly be granted: that science is now become an inestimably important factor in the furtherance of human welfare; that Britain has played a magnificent part in the erection of the scientific edifice, and is, therefore, largely responsible for the coming victory of science as an instrument of altruism; and yet, most noteworthy of paradoxes, that it is Britain herself which is the most backward among the great nations in her recognition of the facts which she has done so much to bring about. Surveying these statements, am I not justified in making the deduction that the present backwardness in the recognition of science, *displayed by the nation which has already done so much for science itself, and also directly for the good of mankind, is not merely a national or imperial, but a planetary disaster?*

It is, of course, a valid and practical argument of Sir Norman Lockyer's that we should build universities for the same reasons as counsel us to build war-ships; and that the continuance of our national existence will depend on a recognition of science, like that of our "rivals," the Germans. But, while granting the truth of all that he has said, I would rather commend to you the cause and the claims of science in Great Britain on the grounds that without science she cannot survive, and that without her the coming of the golden years must be delayed, and, all the world over, the reign of the Prince of the Power of Darkness must be the longer maintained.

Carlyle called political economy "the dismal science," and the historian who gave us, among other inaccurate things, an estimate of Carlyle, has gone further and committed himself to the statement, also inaccurate, that "political economy has been banished to the exterior planets." Now, dismal or not, this science contains certain truths of the first importance to this country, and therefore to the world. One is that, as Sir Norman Lockyer points out, the great prosperity of Great Britain during the latter half of the nineteenth century was due to our relatively early development of our vast material resources. We lived last century on our material wealth; but henceforward we must live, if we live at all, on our brains. All myopic talk for or against this, that, and the other tax apart, the broad fact remains that we of Great Britain, except when living on our capital, now get our daily bread in exchange for our brains. The population of this country lives on its wits, if I may say so. And the problem of problems for our statesmen, when they shall appear, is to increase the supply of those wits. In other words, the national need at this hour is what Mr. Chamberlain terms the "parochial" matter of education;

and I use the word in the narrow and familiar sense. Scientific education, and especially scientific education in science, is at once, in the word of our first politician, a "parochial" matter, and, in the verdict of contemporary history, the national need.

Another former president of the British Association, Sir James Dewar, has told us that we are two generations behind the Germans. Sir Oliver Lodge has sounded the same note of warning. As we are certainly behind the Germans, so we are certainly behind the United States of America. The commissioners who have lately been there all descant upon the extraordinary thirst for and belief in education which characterises the young American. They say it has no parallel on this side of the Atlantic.

Every one who reads the papers knows well how German science has affected our trade. We know of the aniline-dye industry, once in British hands, now a great source of wealth to Germany simply because the German manufacturer employs and believes in the trained chemist. We hear of single German firms which employ as many chemists as all the English manufacturers put together. We know that we pay Germany large sums of money every year for perfumes and drugs because the undiscriminating tax on alcohol causes the British manufacturer to pay shillings for an amount of this indispensable substance which his German rival can get for fewer pence. We have heard how the Germans have grown potatoes where nothing else would grow, have increased the yield of the vegetable forty per cent. by scientific agriculture, have increased its food value by scientific cooking, and send us continually large quantities of starch and potato-spirit which we might just as well have produced for ourselves. One would think that there could now be surely no need for such an essay as this. Yet there is urgent need.

You will answer with an objection which is worthy of all consideration. You say that all this is the most miserable materialism; that there are better things than commercial prosperity; that education means something nobler than the knowledge how to manure potatoes; and that, in fine, I am urging the prostitution of science to mammon. But I have forestalled your objection. The argument is not that our material prosperity is the ultimate end, but that such prosperity is necessary to our continued existence as a free people, therefore to the continued advancement of science in these islands, and therefore to the continued rapid amelioration of the lot of humanity. I am entirely at one with that hasty Hebrew who said that "righteousness exalteth a nation." But I urge the claims of science since without it the nation threatens to cease to exist, or to exist with its present potentialities for righteousness at home and abroad.

And I make no apology for using the word "education" in the narrow sense of imparting knowledge, or in the somewhat less narrow sense of training the mind to deal with knowledge. The narrower idea of education must first obtain if we are to survive at all. Thereafter we may widen our idea of education by adopting the noble conception of our greatest thinker. To the reader who has followed me thus far, I offer these words of Herbert Spencer—ample reward for his forbearance: "Of the ends to be kept in view by the legislator, all are unimportant compared with the end of character-making. . . . This alone is national education."[1]

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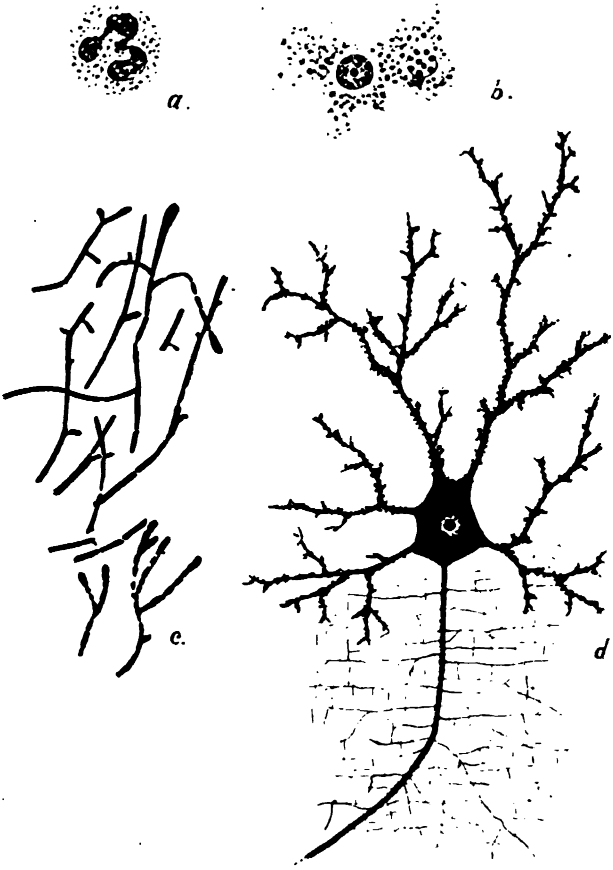
[1] This quotation is from the *Study of Sociology* (1873). Compare *Times*, May 14, 1904, referring to the new Educational Code issued the day before: "The remarkable thing here is the plain definition, for the first time officially given, that formation of character is the first business of the elementary school." In a century or two this sentence will doubtless occur again, the word "legislator" being substituted for "elementary school."

THE LIVING CELL

It is well to begin at the beginning; and for us, who are many-celled organisms, that beginning is the living cell. It is the cardinal platitude of biology that the cell is the unit of life; and, as such, its origin, immediate and primeval, its structure, its needs, and its life-history, are among the most interesting and the most sublime problems conceived or conceivable by science. Of first causes, it is true, science has some word, and of the origin, let us say, of solar or stellar systems; but the mind that postulates first causes or that formulates a nebular hypothesis is an expression of the highest development of cell-activity, and is manifested in a "form divine" itself developed from a single cell. It is this association of the living cell with *mind* that gives it such supreme importance. Modern physical chemistry, and notably radium and radio-activity, are now claiming the attention of all thinking people, since they raise questions not merely of practical, but of the utmost philosophical importance. They carry us to the very bounds—as we cannot but believe—of human knowledge, and leave us vainly questioning ultimate reality.

But we have no evidence of what we call mind associated with radium, and we must remember that mind is the implement and means by which we study radium and all other phenomena, including those of mind itself. Therefore we cannot surrender the claim of the living cell to the place of supreme importance. The two thousand millions or so of living cells in my brain and yours are involved in the history of the words before you. Whatever we do, of whatever we think, or refuse to think, we cannot escape the living cell without which, as far as we know, there is no evidence of mind anywhere to be found.

What, then, is this consummation of the material universe—this which may in one form become a Shakespeare or in another, so similar yet so incalculably different, turn our morning milk sour, and yet which is essentially always the same? You may study it in a thousand forms. If your realm of thought be "the proper study of mankind," in your fellow-man you study the cell. If those beings whose life need have no period, the immortal trees, attract you, in the oak or the acorn you study the cell. Under the microscope, magnifying, how inadequately, one thousand five hundred or two thousand diameters, you shall detect no particular difference between the corpse of the cell that would have been a man or of the cell that would have been an oak. Be your fancy more bizarre, you may study the cell in that accursed plant, one-four-thousandths of an inch in length,



TYPES OF CELLS

a. White blood corpuscle (human), polymorphonuclear leucocyte (showing peculiar shape of nucleus).

b. Amœba. *c.* Streptothrix (low vegetable organism).

d. Nerve-cell from cortex cerebri of man, showing the many tree-like processes (supposed to be nutritive), and the one axis-cylinder process, which is the essential constituent of a nerve.

the tubercle bacillus, which sends down into the grave one in seven of the human race. Or you may prefer the study of one of your own guardians, the white corpuscles of the blood, and in these living entities, ten thousand to the cubic millimetre of that so-called "fluid," you shall find all the characters of a cell indistinguishable from the common *amœba*, which is only one cell from first to last.[1]

There is a would-be modern tendency—something "really up-to-date"—to believe that there is now no such thing as scientific dogma; that the more we learn the less we know; that we are sure of nothing and never shall be. Fortunately facts remain facts, with the peculiar property that they are independent of what may be thought of them; and logical processes are valid in despite of time or space or minds to which they are but as an idle tale. It may be asserted as a proven and irrefutable scientific fact, as certain as gravitation or the law of the conservation of matter, that every living cell on the earth at this moment, whether plant or animal, whether living alone or a member of a complex community, was derived from a pre-existing cell. *Omnis cellula e cellula* was the simplified and final form given last century by the great Virchow to the dogma propounded by his English predecessor Harvey in the phrase, *omne vivum ex ovo.* Every living thing is from an egg; and every living thing (that is to say, every cell or collection of cells) is from a pre-existing cell.

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[1] See illustration facing p. 12.

Carlyle somewhere says that "every man is at heart a proselytiser," and I confess to a whole-hearted zeal in asserting a doctrine so cardinal and so significant. The tremendous deduction, raising problems incredibly beyond speculation, must be faced. Life had a beginning on this planet, and that beginning was apparently once and for all. How, no one has yet begun to tell us with anything like success. Since the famous experiments of Pasteur, which conclusively proved that spontaneous generation is a myth—at any rate in the present epoch—men of science have done their best to produce life in the laboratory, and have completely failed. Thus baffled, they have tried to explain the origin of the first living cells at some period in the distant past, when the temperature of the earth's surface had cooled sufficiently to permit of the existence of water upon it in the liquid state, which is necessary for the living cell. When the present writer was studying zoology under Professor Cossar Ewart, not so many years ago, that distinguished biologist felt himself compelled to resort to the supernatural for an explanation. Professor Ernst Haeckel, of Jena, to whom the supernatural or any hint of it is *anathema maranatha*, and who is the most distinguished biologist at present living—as well as a scurrilous opponent of Christianity—has advanced what is called the "carbon-theory," which seeks to explain the origin of living matter by certain of the properties of carbon. Cossar Ewart and Haeckel would each consider the other's theory extremely unsatisfactory; and, so far, the vast majority of scientists would agree with each of them. How the first living cell came into existence on our planet we have no idea. But, some thirty years ago, Lord Kelvin thought to avoid the difficulty by suggesting that the first living cell on this planet really arose elsewhere—that it was conveyed by a meteorite from "the moss-grown ruins of another world." But meteorites do not come from other worlds; in passing through our atmosphere they acquire a temperature sufficient thoroughly to "sterilise" them, supposing them to contain any germs of life; and, even if Lord Kelvin's guess were correct, it would merely remove the difficulty from this planet to another. Of the origin of life science at this hour knows nothing whatever.

But these are transcendent issues. Let us examine the features of this unit of life. It is a little mass of matter, with or without a definite boundary, and it contains a denser speck called the nucleus—that is all. Sizes and shapes vary. The nerve whereby one is painfully aware of a corn, and which controls the growth of a toe-nail, is the direct prolongation and continuation of a cell just outside the spinal cord more than three feet away; but the little mass and the central speck are the essential rude anatomy even of this so highly differentiated cell. The nucleus is a netlike structure which is the governor of the cell. Of the destinies of the whole—high destinies, they may be—the nucleus is the arbiter. It initiates every cell-division, and controls, in higher organisms, every cell-differentiation. Conceive, if you can, the complexity and power of the nucleus of the original cell from which each of us was developed. The entire cell consists of a substance called protoplasm, which, in Huxley's phrase, is the "physical basis of life." Protoplasm, or living matter in its lowest terms, contains, invariably and necessarily, six elements: carbon, oxygen, hydrogen, nitrogen, sulphur, and phosphorus. The phosphorus is found within the nucleus, and is characteristic of the "nucleo-proteids" of which the nucleus is composed. The complexity of the molecular constitution of protoplasm is beyond conception, as is the invisible structure of the cell itself. The cell, or the protoplasm of which it is composed, performs, needless to say, the same functions as we do, or as the cedars of Lebanon did in the days of Solomon and do to-day. It breathes, of course. That is to say, it takes in oxygen (O_2), combines it with carbon (C), and gives out carbonic acid (CO_2). In other words, it burns. Necessarily, therefore, it is combustible; as are our many-celled bodies; as is also our food, which consists of the bodies of plants or animals defunct. The cell must burn, must breathe. That is an absolute condition of its life; applicable universally—to the *bacillus tuberculosis*, to the germ of a man, or to the man himself. Even the *anaërobic* bacteria, which Pasteur discovered and so named because they grow only in the absence of free oxygen, yet have been proved to take oxygen from the compounds in which they live. In an oxygen-free medium they cannot survive. It is further worth noting that this indefeasible rule as to the absorption of oxygen by the living cell is not a simple matter of combination as in a fire. The oxygen is first taken into the living substance of the cell, which breathes not raw oxygen directly obtained from its surroundings, but *intra-molecular* oxygen which has been already complexly incorporated with the living substance.

And, since the cell develops and grows and burns, it must have fuel; or food as we call it. This food, like ours, must contain the six elements of which the cell is composed, as well as some others, such as chlorine, contained in common salt, the chloride of sodium. The plant-cell takes up these elements in very simple forms and builds them into exceedingly complex bodies known as proteids or, less accurately, as albumins, and into starches and sugars. The animal-cell cannot effect this synthesis; and here is the nearest approach to an essential distinction (one of chemical power) between the two. Since from the proteids it replenishes and regenerates its constantly burning protoplasm, the animal-cell must, therefore, utilise the plant-cell for its food. Hence it is that without plant life animal life cannot be. And as the plant-cell's power of building up these complex substances depends directly upon the sun, we recognise in him a necessary of all life, vegetable or animal. But the cell is still supreme. The sun himself cannot think. The cells of the gray surface of the human brain can conceive of a power behind the sun. The living cell stands to-day where it ever has stood; before its attributes, the mystery of which, though now well defined, is as yet unsolved, the "intelligible stars" and the inanimate nebulæ still pale their ineffectual fires.

THE GREEN LEAF

HERE, in the New Forest, surrounded by oak and beech and birch; one "ethereal minstrel" singing, yet scarcely breaking the eloquent silence; the green in its glory everywhere, unbesmirched by the carbon from man's imperfect combustion of the coal—the "entombéd tree"—which ranks ancestral to the denizens of the New Forest of to-day, what more fitting to discuss than the cosmic function of the green leaf?

Here and there is the *Drosera*, or sun-dew, one of the three or four carnivorous plants found in the British Isles. Its tiny red stalks are crowned with viscid hairs, ever moist, waiting for their insect prey. This sun-dew is the insignificant exception to all around us. It obtains its food as an animal does, by the taking of life; its life at the cost of another's death. Far otherwise is it with all the placid, stately life around it, seeming-silent in the majesty of its unhasting process. From no fellow-creature's life-blood do these green leaves suck their food, but from the insentient air and the sun in his strength.

The atmosphere contains a small but all-important and very constant quantity of carbonic acid (CO_2), derived from the oxidation—the combustion, that is—of carbon in the process of respiration, which is common and essential to every living thing, animal or plant; and also from the oxidation of dead organic matter elsewhere. So crowded is the earth with animal life and with the dead débris of vegetable life that the oxygen of the air—it was once thought—must surely be one day used up and replaced by carbonic acid; so that the scientific imagination pictured the "Last Man" of the poet as gasping for air—for the last few remaining molecules of oxygen—on the peak of Everest, while all his fellow-beings, animal and vegetable, lay drowned in the rising sea of carbonic acid below. But recent investigation has dissipated, at least in part, this scientific nightmare. It has been shown that the percentage of carbonic acid in the air—.04 to .06—is practically constant at all times all the world over. Man may cut down a huge forest and plant himself upon its site. The natural deduction would be that the quantity of carbonic acid in the air of that place would greatly increase. Or the reverse process might take place, whereupon the percentage of atmospheric acid should greatly decrease. But the air of a forest and the air of a town—especially if estimated at night, when few fires are burning—contain practically the same percentage of this most important constituent. This fact was long an unsolved riddle. There appeared to be no explanation for this remarkable and most beneficent equilibrium. Beneficent we could readily understand it, for the human process of respiration is entirely at the mercy of the percentage of different gases—oxygen and carbonic acid—in the respired air. But it is now believed that the sea furnishes the equilibrating agent. Sea-water contains a varying proportion of magnesium carbonate and magnesium bicarbonate, the latter salt containing twice as much carbonic acid as the former. There is reason to believe that the percentage of carbonate to bicarbonate varies with the percentage of carbonic acid in the air above the sea. When that percentage tends to rise, the "partial pressure" of the carbonic acid in the air also tends to rise, and the result of raising this pressure is to drive the superfluous carbonic acid into the carbonate of magnesium, turning it into bicarbonate. If, on the contrary, owing, let us say, to the proximity of a large forest to the sea, the partial pressure of the carbonic acid in the air tends to fall, some of the bicarbonate of magnesium in the sea-water is decomposed into carbonate and carbonic acid, which latter is restored to the air, the balance being thus restored. It therefore appears that all animal and vegetable life upon the land are immensely indebted to the presence of these salts in sea-water, since they render possible, in accordance with the laws of what modern physical chemistry calls *dissociation*, an automatic arrangement for regulating and keeping constant the amount of atmospheric carbonic acid. The fact that the percentage is so constant in different places, the incessant movements of the atmosphere easily suffice to explain. The percentage in the air of a great town certainly rises during the day, but when the fires go out the wind is soon able to restore the original state of things. This is one of the reasons why night air is healthier than day air—despite the popular prejudice to the contrary.

Now, let us see the meaning of this carbonic acid to the plant. That was a wise Frenchman who made the saying about two blades of grass "where one grew before." For the green plant obtains its food, or at least the carbon of its food, from that very carbonic acid; retaining the atom of carbon but giving back to the thus regenerated air the two atoms of oxygen. This is accomplished by those cells of the plant which contain the green matter called chlorophyll.[1] Iron, we may remark, is an indispensable constituent of chlorophyll, and, therefore, of practically all life on this planet. Similarly iron is an indispensable constituent of the hæmoglobin, or red colouring matter of the blood of animals; but were there no chlorophyll in the leaf there would be no animal, since the animal world depends for its food in the last issue upon the plant. The protoplasm of the plant-cell, mysteriously aided by the chlorophyll, can thus decompose carbonic acid *only in the presence of sunlight*, or, rather, of those ethereal waves, invisible to our eyes, that lie

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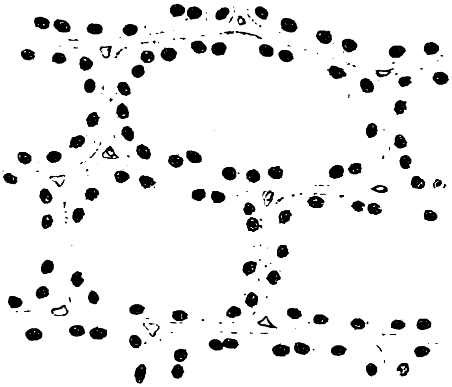
[1] See illustration facing this page.



CHLOROPHYLL CORPUSCLES IN THE PROTOPLASM OF THE CELLS OF THE PROTHALLIUM OF A GERM. (Highly magnified.)

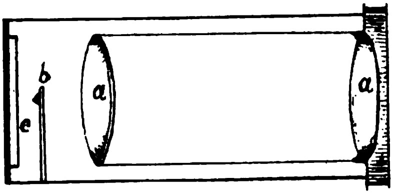
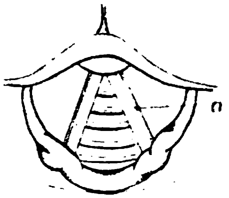


DIAGRAM OF SPINTHARISCOPE

a. Lenses.
c. Sheet of zinc sulphide paper.
b. Pointer with radium on under surface.



NORMAL LARYNX AS SEEN FROM ABOVE BY THE LARYNGOSCOPE
a. Vocal cord.

beyond the violet end of the solar spectrum. In these actinic, "chemical," "photographic," or ultra-violet rays—one might indeed, in virtue of their high function, venture to call them *biogenic*—and in their source, the sun, do we find an essential condition of all earthly life whatever. A great theoretical truth, you will agree with me. It affects practice in a thousand ways. Here is a small one. Flowers and plants are beneficial as well as beautiful in a room in daylight. They purify the air by this unique power I have described. But at night they are powerless. Day and night, of course, they breathe, taking in oxygen, giving out carbonic acid, and thus tending to vitiate the air. Under the influence of sunlight this familiar process is more than neutralised, so far as you are concerned, by the converse process, but at night the plant continues to breathe and consume the air, whereas its salutary function ceased at sundown. Therefore remove all plants and flowers from a bedroom at night. The simultaneous performance of two exactly opposite functions in the daytime is perhaps rather confusing. At any rate, your case and mine is simple enough. Day and night we simply add to the carbonic acid in the air, nor can we regain the valuable carbon squandered thereto except through the mediation of the plant.

Observe, then, that the animal can neither detach the carbon from carbonic acid, nor, if the carbon be given to it ready-made, can the animal utilise it. If you eat a charcoal biscuit you embody—may I say?—the invaluable element, but you cannot utilise it. You might as well swallow the Koh-i-Noor, that celebrated bit of carbon. Nor do the naughty children who amuse themselves and discipline their parents by eating coal derive any benefit therefrom. The plant can better obtain the carbon from carbonic acid, and utilise it thereafter. And the measure of the heat given out by a fire is the measure of the tremendous energy displayed by the plant protoplasm in effecting this decomposition. Has not Goethe, following Empedocles, told us how carbon and oxygen love each other, how passionately they fly, lover-like, into each other's arms? The union is extremely firm, as is testified by the quantity of heat evolved by a fire during the process of combination, and by the chemist's great difficulty when he seeks artificially to undo it. Yet every green leaf in the world is quietly exercising this power. Can we in any way explain this remarkable decomposition of an extremely firm compound at a quite low temperature? The chemist can effect the dissociation of carbonic acid at a temperature of thousands of degrees, but not at the ordinary temperature of the air. What is the rôle of the indispensable chlorophyll in this, the most important instance of dissociation that we know? We must regard it as a means of storing-up or, so to speak, focussing the actinic rays of the solar spectrum. Quite recently the chemist has been able to imitate this process, but "in a very feeble way," as Sir James Dewar himself says. The distinguished professor at the Royal Institution has succeeded in decomposing a weak compound called iodoform—very different from the extremely strong compound which the green leaf decomposes—by simply passing electric light through it, free iodine being liberated. But though a poor parallel, it is a true one, a compound being dissociated by the actinic rays in electric light just as the carbonic acid is dissociated by the actinic rays of sunlight—but aided by the indispensable chlorophyll. It seemed to the writer that the chlorophyll acted somewhat like a ferment, causing a chemical change while being unchanged itself; but Professor Dewar was good enough to tell him at the Royal Institution that we must regard the chlorophyll not as the active agent, but simply as the director of that agent, which is the actinic ray.

Let us trace a little further the history of the carbon thus obtained by the plant. If it simply remained as uncombined carbon it would be of no use to the vital processes of the plant, nor would it be of any use to us. Now to trace the history of the carbon, we must ascertain whence the plant gets its water. It has begun to rain, let us imagine, every leaf is dripping wet, yet not one is absorbing a single molecule of water. It is the function of the leaf, as of our skins, to give off water, not to take it in; a process known as transpiration—hence the French word for perspiration. The plant sweats by its leaves, thereby keeping itself cool just as we do, but it drinks only by its roots. The water thus absorbed passes up the stem against gravitation by a remarkable mechanism which cannot here be described, to the leaf where the carbon awaits it. The leaf is the laboratory of the plant, and indirectly, therefore, of the animal. Its protoplasm combines carbon and the water so as to form the carbohydrates starch and sugar. Now the formula of a typical sugar, such as glucose, is $C_6H_{12}O_6$. This molecule may obviously be supposed to be made up of six molecules, each having the formula CH_2O. Now CH_2O represents the simplest possible combination of a molecule of H_2O from the root with an atom of C in the leaf obtained from the CO_2 of the air. Now there happens to be a substance having the formula CH_2O. It is known as formalin, or formic aldehyde, or formaldehyde, an excellent antiseptic. It is, therefore, very reasonably supposed by botanists that formaldehyde, made in the leaf, is the antecedent of the sugar of the grape and the starch of the potato, since by packing six formalin molecules together, in some particular way which organic chemistry has not yet disclosed to us, you get the exact formula of glucose, or grape sugar. (It is necessary to say, however, that the presence of formaldehyde has *not* yet been demonstrated in the leaf.) Well, of course, the Irishman eats the potato, and turns it into muscle and enthusiasm and wit; or, in general terms, the animal world, including ourselves, lives upon the plant or upon animals, such as the sheep, which have lived upon the plant. We have, therefore, traced energy, the truly unknowable, in its transformation—dare we say?—from sunlight into thought, the equally unknowable, where we must leave it; for who can follow thereafter its eternal course? But we have also traced carbon from the carbonic acid of the air to its complex combinations in the muscle and brain of the animal. In them it is oxidised, exhaled by the lungs as carbonic acid once more, and given to the air—from which the plant obtained it. This, then, is the carbon cycle, and it shows the plant to be, in Sir Michael Foster's excellent terms, essentially *anabolic*, or building-up, while the animal is essentially *katabolic*, or breaking-down. The element is thus composed, decomposed, and recomposed by living matter, thus helping to cover the dead earth with life. Many other elements are, of course, involved, such as oxygen and also iron, which is essential both to the chlorophyll, and to the hæmoglobin, the vehicle by which the blood conveys the atmospheric oxygen from the lungs to the carbon of the tissues. Phosphorus, sulphur, and nitrogen are similarly taken up by the plant (though in their case by the root and not the leaf), and are synthetised into complex forms in which they are available as food for the animal. Lastly, the animal dies and returns to the dust. There his body is resolved by microbic agency into simple sulphates, phosphates, and nitrates, which we call manure, and in which form they are again taken up by the plant. So said Tennyson:

THE CYCLE OF LIFE

"And from his ashes may be made
The violet of his native land."

As we dwell, we living things, in this our "isle of terror," each of us is inalienably bound to all the rest. So you may be selfish for a century, but, at the last, others will claim your dust. For altruism is the law of nature.

ONE—YET DIVISIBLE

IT is hardly more than a century since John Dalton began the setting-down of his *New System of Chemistry*. With that great work began the reign of the atom, one and indivisible, which lasted for a few months less than a hundred years, and which has lately yielded to its successor, the atom that is yet one, indeed, but many times divided within itself. Never, save in the Cosmos itself, was unity in multiplicity better illustrated.

What might appear to be the fundamental conception of Dalton, therefore—the belief, that is, in atoms as the ultimate particles of matter—is now obsolete, and one might say in his haste that the name of Dalton might now be decently forgotten. If the smallest, simplest, and lightest atom known, that of hydrogen, consists of some seven hundred parts, and is in reality a microcosm well-nigh as complex as the solar system, it might be thought that we should drop Dalton and 1803, and begin again *de novo* in this year of grace. And this idea has gained much credence. Those critics who answer to the familiar Disraelian adaptation of a bitter French definition are avenging themselves for their constructive failure by telling the public that atoms are a myth, that they were never more than a "working hypothesis" (phrase beloved of such critics), that the kinetic theory of gases, "the whole structure of modern chemistry," the conservation of energy, and all the inferences from these assumptions, are "swept away at a blow." Such critics have always been, from Ionian days until ours, and it would be beside the purpose to notice them but that their attitude embodies an exceedingly common fallacy. They think that facts cease to be facts directly the accepted details of their explanation fail. So let us have it clearly set down that if there be such a thing as an objective fact, if there be such an entity as truth, it is so independently of our attempted explanations thereof; the interpretation or theory cannot condition the validity of the thing interpreted. No one by taking thought can affect facts; but only his relation to them. And before going on to what Dalton achieved let me quote from the *System of Logic* what Mill pointed out when Daltonism was young:

> "If one link of an argument breaks, the whole drops to the ground; but one step towards an analysis holds good, and has an independent value, though we should never be able to make a second. The results of analytical chemistry are not the less valuable, though it should be discovered that all which we now call simple substances are really compounds. All other things are, at any rate, compounded of those elements; whether the elements themselves admit of decomposition is an important inquiry, but does not affect the certainty of the science up to that point."

This might have been written as a warning for the present case, which is that the divided, the microcosmic atom is as certain a basis of modern chemistry as the indivisible atom was a year or two ago.

What, then, did Dalton accomplish? The Greeks had had, long before him, the obvious conception that matter consists of small particles. That would occur to any one who saw a crystal ground to powder in a mortar. Newton believed in the particulate nature of matter. But Dalton went further and showed that these atoms are of a fixed weight in any given element; and that all chemical actions proceed according to the laws thus determined. He says: "An inquiry into the relative weights of the ultimate particles of bodies is a subject, as far as I know, entirely new; I have been lately prosecuting this inquiry with remarkable success." He then gives his first crude table of atomic weights. No one before had ever ventured to weigh, even relatively, these particles, which were indeed regarded in a quasi-metaphysical light.

Following Dalton, then, chemists have weighed, relatively to one another, all the known elements, from hydrogen—the atomic weight of which, being the least, we call *one*—to radium, weighed the other day, the atom of which is, according to Madame Curie, two hundred and twenty-five times as heavy. Take water as a simple application of our knowledge. Its formula is H_2O. Now the oxygen atom is sixteen times as heavy as that of hydrogen; the atomic weight of oxygen is sixteen. But two atoms of hydrogen combine with one of oxygen to form water. If, therefore, the chemist mixes an ounce of hydrogen with eight ounces of oxygen and passes an electric spark through the mixture, it ignites; the hydrogen is burned or oxidised, and water is formed. And the point is, that no residue of either gas is left. They unite exactly because they have been mixed in the proper proportions, based on their relative atomic weights. Now mix one ounce of hydrogen with sixteen of oxygen; if they unite altogether, the atomic theory says that two atoms of oxygen will unite with two of hydrogen; and so they do. The result is H_2O_2, peroxide of hydrogen, the antiseptic basis of "sanitas," and the body which bleaches dark hair to a certain fashionable yellow, known to the intelligent cynic as "peroxide hair." All other chemical actions proceed similarly. Take the formula of any molecule you please; that of sulphuric acid, H_2SO_4, for example. According to the atomic theory two atoms of hydrogen and one of sulphur and four of oxygen go together to form a molecule of sulphuric acid. Combine these elements in their "atomic proportions" (in proportion to the weight of their atoms, that is), and sulphuric acid will result, without excess or deficit of any of them. But one would need pages to show the value of this theory, especially in organic chemistry, where "rings" and "chains" of atoms are combined to form molecules that may contain hundreds of them. Suffice it that Dalton is an immortal name.

And yet the atom is a microcosm. Take the simplest, and let us look at approximate figures where details cannot yet, if ever, be precise. The atom of hydrogen is now believed to consist of a central core, or "ion," surrounded by about seven hundred mobile particles called "electrons." The mercury atom has one hundred thousand electrons. Those of radium are more numerous still. We do not know whether an atom of mercury differs from one of hydrogen in the number of its electrons only, or in their movement, or in the nature of the ion, or in what. At any rate, the "periodic law" of Mendeleef, the great chemist of St. Petersburg University, places the elements in groups and series, and shows that there is a relation between the atoms of different elements: so that "the real is one," as the Rig-Veda has it.

Now let us just consider the size of an atom. Lord Kelvin has studied the thickness of the film of a soap-bubble as shown by the changes in its colour, and, using the wave-lengths of light of differing colours, has mathematically demonstrated that if a drop of water were magnified to the size of the earth its atoms would be between the size of small shot and of cricket-balls. Now conceive such an atom and magnify it to the size of St. Paul's Cathedral. How large the ion then would be I know not, but we are told that the electrons would be about the size of this full stop. And so roomy, in relation to the size of the electrons, is the atom, that they are relatively as far from one another as the planets in the solar system. Consider, then, the inconceivably minute atom of hydrogen as a copy in miniature of a solar system, wherein the ion is the sun, and the electrons are his seven hundred satellites; nor need the electrons ever approach relatively nearer to one another's orbits than our earth and Mars, whose mean distance from us is sixty millions of miles. Lastly, take the molecule of hæmoglobin, the red colouring matter of the blood, which is supposed to have the biggest molecule known, containing something like a thousand atoms. I think we might compare it to a star-cluster such as the Pleiades. If each sun in that cluster had some thousands of satellites, the whole would resemble one hæmoglobin molecule, consisting of many "inly linkéd" atoms, each of which, in its turn, is comparable to a solar system.

One profound truth, then, these analogies teach us—that large and small, as we use them, are not absolute, but relative terms—relative to the mind of man who coined them. You may say, if you please, that the atom—so small that no microscope will ever permit the human eye to see it—is a solar system in miniature; and may wonder at its minuteness. But you might just as rightly call the solar system an atomic system in magnification, and wonder at its immensity. These terms are adapted to the mind of man, and modern science has gone far to assert the truth of that great saying of Protagoras, "Man is the measure of all things."

Meanwhile unity defies all considerations of space, for the Pleiades and the atoms of which they and you and I are composed are alike subject to universal and unheeding law.

ATOMS AND EVOLUTION

RADIUM has supplied us with the first experimental proof that one so-called "element" can change into another; that evolution applies even to what were once mistakenly called the "foundation-stones" of the material universe; and that Clerk-Maxwell's description of the atom as bearing upon it the stamp of the "manufactured article" can no longer be accepted. By way of marking progress we may recall the famous words of the great physicist at Bradford in 1873; always remembering that the greatest mind of the time had rejected this view of the atom and its Artificer-God, many years before: "Natural causes, as we know, are at work, which tend to modify, if they do not at length destroy, all the arrangements and dimensions of the earth and the whole solar system. But though in the course of ages catastrophes have occurred and may yet occur in the heavens, though ancient systems may be dissolved and new systems evolved out of their ruins, the molecules [atoms] out of which these systems are built—the foundation-stones of the material universe—remain unbroken and unworn." And now radium has taught us that atoms grow and decay like all else; that they are not manufactured but evolved! The researches of Thomson of Cambridge, his pupil, Rutherford of Montreal, and Ramsay and Soddy of University College, London, have now gone so far that one may try to indicate some of the features of atomic evolution as it has been demonstrated by the last-named observers.

Radium, as we all know, gives off a great many different kinds of radiation, but we need fix our attention on only one set of these, much the most interesting and important, which have been called by physicists the alpha rays. They represent by far the greater part of the energy given out by radium, and the emission of them constitutes the very act of atomic evolution in this instance. Sir William Ramsay has not discovered the "philosopher's stone," but he has demonstrated without its assistance that for which the alchemists sought it. He has not yet converted lead into gold, but he has observed the transformation of radium into helium, and Professor Curie told the Royal Society, when it presented him with a gold medal, that he would do his best to convert it into radium. The transmutation of the elements is a proven fact, and we owe the proof to the alpha rays of radium.

Now what are they? Their most important characteristic is that they are *ponderable matter*. They consist of actual particles, not merely of undulations in the ether, like sunlight or Röntgen rays or heat-waves. And they shoot out from radium at an astounding speed, probably about one-tenth the speed of light—say at about twenty thousand miles a second. They are by no means the fastest-moving matter shot out from radium, for the beta rays, which also consist of material particles, move with a speed approaching that of light. Until these discoveries it was thought that the fastest-flying matter known was that of some of the "runaway" stars, such as Arcturus, so familiar to observers in the northern hemisphere. Arcturus is moving at the rate of about one hundred miles a second, yet he is but a laggard compared with the alpha particles from radium, which move two hundred times as fast.

So much for their speed; but that is not the really important thing. They have no penetrative power and are easily imprisoned in a glass tube, in which a gas of unknown nature appears, doubtless formed from them. But Ramsay and Soddy found that when this unknown gas is watched for about four weeks, its spectrum changes into that of helium. In other words, the evolution of the radium has given rise to the helium by means of the alpha rays. Now the weight of a radium atom, as compared with the weight of the lightest-known atom—that of hydrogen, which we call 1—is 225, according to Madame Curie. The weight of a helium atom is about 2.02—that is to say, about twice the weight of a hydrogen atom, and just about one-hundredth part of the weight of a radium atom. It is probable that the radium atom breaks up into about a hundred particles, each of which is, so to speak, an immature atom of helium, and these particles constitute the alpha rays. When they have had four weeks in which to settle down and mate with one another — for the atoms of a gas generally go about in pairs— then the spectroscope reveals their identity with helium. This, then, is atomic evolution taking place sensibly before our eyes. Any one may witness part of the process by purchasing a spinthariscope[1]—the little scientific toy invented by Sir William Crookes. When you hold the little instrument close to your eye in the dark you see an incessant shower of sparks that shoot out from a central point. These sparks of light are due to the impact of the alpha particles against a sensitive screen of zinc sulphide which is placed at the end of the tube. The beta and gamma rays are not arrested, and pass on in all directions—many of them into your eye and probably right through your head—but the alpha particles are too big, and are stopped by the screen, despite their tremendous velocity. As they strike the screen they crack the crystals of zinc sulphide with which it has been covered, and thus produce the flashes of light which you see. The instrument costs a guinea, but, though the speck of radium in it is too small to be visible, it will continue to emit these particles at this astounding speed, day and night, in season and out of season, for at least twelve hundred years. It follows that the most abundant source of energy in the universe—a source all but inexhaustible—is to be found *within* the atom, where until recently no energy was suspected. Some day we may expect to tap it, and then we need not deplore our exhausted coal-mines or nitrate-fields.

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[1] See illustration facing page 22.

The truth of this matter seems to be that, though all atoms are divided *within* themselves, the heavier atoms, such as those of radium, thorium (α and β), and uranium, are divided *against* themselves, and therefore, like the house of the parable, they *cannot stand*. Their internal dissension—so to speak—constitutes the intra-atomic energy which is now recognised to be a *unique source of power*, more ample than any other known. This source of energy had never even been suspected until the discovery of radio-activity or atomic evolution. The fundamental law of the conservation of energy is not in the least degree impugned, but the actual amount of energy in the cosmos is infinitely greater than had been supposed. And as matter is merely a manifestation of energy, we must realise that, immeasurably great as we already knew the sum of all things to be, our conception was immeasurably short of the reality which radio-activity has now revealed to us. No finite mind can conceive the stupendous sum of cosmic power.

CRICKET

ASSIDUOUSLY buttoning his left glove, the batsman wends his way to his wicket. His intentness and his difficulty in that adjustment may be correlated with the presence of more or less "funk." Now "funk" is an actual psychological entity. One may define it as the effect of the emotion of fear upon the neuro-muscular centres, the nerve-cells that control muscular action. To the cricketer this is anathema, to the singer a fearful joy. It has no value for the batsman; it is an æsthetic force for the vocalist. Mr. Edward Lloyd has admitted that he never sings so well as when he is slightly nervous, which is to say that this activity of the emotional centres lends tears or laughter to the voice. But the batsman dreads "funk," for his skill is only incidentally æsthetic. If you take the trouble, as I once did, of observing the frequency with which a batsman makes nothing in both innings—earns a "pair of spectacles"—you will find that the ratio exceeds that which could be accounted for by chance. The obvious explanation is that the batsman who failed to score in the first innings is all the more likely to repeat his distressing feat in the second, since that nice muscular co-ordination upon which depends his success is unbalanced by the memory of his previous failure and the apprehension of its repetition.

But whether or not he be hampered by this "moral fear," the batsman has next to come to terms with what we know as physical fear. For when he faces the bowler he may remember that a cricket-ball is an object of considerable mass—its weight on this planet being five and three-quarter ounces—and possessed, on its course towards him, of no inconsiderable velocity. The crack Australian bowler Turner was tested at Woolwich Arsenal many years ago, and was shown to bowl at sixty-six miles per hour. Now half the product of the mass multiplied by the square of the velocity gives the force of the cricket-ball ($=\frac{1}{2}MV_2$), and this is an exceedingly palpable force if the wicket be bumpy and the ball impinge upon your thigh or eyebrow. The tyro acts in accordance with the instinct of self-preservation, the first law of protoplasm; he therefore steps backward, away from the line of the ball's flight—"runs away from his wicket"—and is inevitably bowled. The first essential of batting (and it applies equally to the bowler who has to stop a hard return or the fielder who must get in the way of the ball and, lest his hands should fail, must "keep his legs together") is, therefore, to defy the natural impulse. So difficult is this that some coaches will fasten the beginner's right foot to the ground so that he cannot budge though he would. And the process by which the batsman "stands up to the bowling," by which you forbear to return a blow or to fling back an angry taunt, by which we exercise self-control and self-restraint, and by which, rather than by speech or reason, we are distinguished from the brute creation, is known as *inhibition*. It is at once the antithesis of volition and its highest expression.

The new science of psychology is, in this year of grace, by far and away the most interesting subject of human thought. The Greeks — or rather those Greeks whom we are officially told to admire —studied mind rather than matter, but to-day our study of matter has led us to the fact that the gray surface of the human brain—the *cortex cerebri*—is, for the denizens of our planet, at any rate, the most wonderful thing in the universe. It has been a long climax from the beginning of our nebula. Evolution is in climax yet, but its acme, for us, is the soft, gray, nervous protoplasm by the subtle chemical changes in your share of which you are at this moment conceiving the import of these words. And the most truly admirable of the functions of the cortex is this inhibition. Can we analyse, then, this faculty by which the batsman stands his ground?

We must first consider what it is that he must inhibit. It must be recognised that the type of all movement, whether in animals or plants, is reflex action. This simply means a movement in response to any external force. The *amœba* moves towards a particle of food that has favourably influenced its sense of smell (as we may figure it), or away from an undesirable particle that has disagreeably affected it. Each movement is a simple reflex action. Volition, as we conceive it, is not involved. Now take the "sixth eleven" school-boy facing the professional at the practice-nets. His sense of sight informs him of the rapid advent of an undesirable particle; he is disagreeably affected by the sensation; he voluntarily gets out of the way, and is bowled, or deserves to be. But, after all, there is not much volition in the matter. It is barely more than a simple reflex, as in the case of the *amœba* or a winking eyelid. The boy will be a man, and the muff a batsman, when he attains to inhibition of his reflex actions.

The vision of the ball takes place in the hindmost part of the brain. Thence nerve-fibres pass to the centres for muscular movement. These are most precisely defined. They lie at the sides of the brain in the "Rolandic area." As a result, impulses are sent downward to subordinate cells in the spinal cord, from which fresh impulses pass to the muscles of the right leg, which is withdrawn; and the pusillanimous batsman's leg stump is knocked out of the ground. The volitional centres, which have not yet been localised, are only slightly concerned in this process, as I have shown. But the trained batsman inhibits the performance of this all but reflex action. I suppose Grace has not run away from a ball for thirty years. His inhibitory centres have gained complete control of the quasi-reflex arc. Where the inhibitory centres are, no one has any idea; but nerve-fibres must pass from them to the cells of the Rolandic area and arrest or modify their motor activity.

Now, since the publication of the *Principles of Psychology*, we have known that *will* is derived, both historically and in the case of each individual, from simple reflex action. Given a certain inheritance, your actions on any particular occasion will depend upon all the experiences of your life; that is to say, upon the influence of your past and present environment—*that is to say*, upon all the sensations which you have ever received. Now, sensations, or sensory stimuli, constitute the first half of the reflex arc, a motor stimulus constituting the other half. Every conceivable effort of the will results in a motor stimulus—either obviously, as in visible motion, or subtly, as in dilating the blood-vessels of a particular part of the brain—which probably happens when we will to attend to anything. But is it not clear that the motion in such or any other cases is not truly volitional? It is simply the delayed or modified second half of the non-volitional reflex arc. As far as I can see it, the truth appears to be that the real willing is —to use a paradox—the negation of willing, the will *not to*, the control of the reflex act, or what the psychologists call *inhibition*. It seems to me that certain very common disorders of the nervous system support this theory that volition is really inhibition, or else the negation of inhibition—*i. e.*, simply letting things take their course. Let me try to illustrate this not very obvious idea. If you cross one knee over the other and tap the front of the first knee, the leg will give a little jerk. This jerk we may look upon as a typical reflex action, though there is some reason for thinking that it is not exactly typical. Now, if anything in the brain has interfered with the normal path of volition from the brain to the spinal cord and thence to the leg, we find that the "knee-jerk" is very much exaggerated, the explanation given being that the inhibitory action of the fibres from the brain is cut off, so that the reflex action, which is normally under restraint, is allowed full play. Does this not look as if the so-called paths of volition were really paths of inhibition, and that an "active" exercise of will is really a refusal to exercise the inhibitory power over an act which is really only the delayed and modified second half of a reflex action? If you accept this view, you will agree with me that when we "voluntarily" do something we "want to do" we are not really exercising any active power, but are simply allowing ourselves to be affected by circumstances; or, in other words, are simply permitting the complex reflex action to take place. The real act of will is in not going when we yet want to go; an act of volition which is really not an act of volition at all, but an act of inhibition. I hold, therefore, as I have tried to show, that inhibition is the only true volition; or, in other words, that the true act of will is the will to refrain. It may perhaps be of interest to find, in the disorders of the nervous system, some material support for what is an old and honoured moral doctrine. But I have wandered far from the pitch!

Of course, inhibition comes in again a thousand times in batting. If you have the bad habit of counting your runs and know that they number ninety-nine, you must inhibit the almost irresistible impulse to smite wildly at the next ball that comes and thereby complete — or lose — your century. (And this reminds me that the tyro is often a "blind smiter." He shuts his eyes and then lets fly. Shutting the eyes is, of course, an obvious reflex, based upon the need for protection of such delicate organs. This reflex of winking is the most rapid known. Obviously it has to be. Those whose eyes could not protect themselves by a rapid enough reflex in this respect were obviously less "fit"—and have not survived.) Then, again, if you are a "stone-waller," accustomed to bat for an hour without making ten runs, and your side needs fifty runs to win, with only twenty minutes to make them in, you must inhibit the long-cultivated reflex—the "habit"—of carefully "blocking" every "half-volley," and must exercise a subtle form of self-control in deliberately conquering yourself and adopting the forcing tactics of a Jessop.

And, now, what is it that puts batting as a feat of muscular co-ordination far above golf or even billiards? It is the fact that the batsman addresses a moving object. He has to "time" the ball; and, assuming that he has acquired inhibition, he is a good batsman almost in proportion to this power of "timing." The ball has twenty-one yards to travel from the bowler's arm to your bat. With fast bowling we may reckon that its whole journey occupies about three-fifths of a second. To get the best result, from your point of view, your bat must meet the ball at one particular moment near the end of this short period. It is as delicate a nervous feat as I know. Your two eyes must work exactly together, else you will receive two images of the ball, which would be fatal. To this end each eyeball must be moved by the co-ordinated action of no fewer than six muscles. The twelve are controlled from one centre in the brain, which not only enables the images in each eye to correspond with one another—so that you may see but one ball at the back of your head—but also enables those images to be formed on the "yellow spot," the most sensitive part of your retina—so that the resultant single image may be well defined. Here another sense is called in—one of the many unknown to those who prattle of a "sixth sense." It is called the muscular sense, and gives you a consciousness of where the muscles concerned precisely are, for, of course, a muscle alters its exact position in space when, and in proportion as, it contracts. The twelve ocular muscles combine to form a stimulus of this muscular sense. This informs you to what degree and in what direction the eyeballs have been moved in following the ball's flight. The muscular sensation is combined and co-ordinated with the visual impression, the two together actually defining for you the precise position of the ball in space. This fact determined, there are somehow set a-going motor centres in the Rolandic area. They command the spinal-cord cells, which transmit the mandate to the cells of the many muscles of the back and shoulders, and arms and legs, which instantly burn the sugar stored within them, and transform its potential into kinetic energy by which they contract and propel the "right spot" of the bat to the exact part of space where the flying ball was previously determined to be—and the batsman scores a boundary or is caught in the long field; the difference between the two being mainly determined by the nicety of his inhibition over his left shoulder-cap or deltoid muscle. And this feat—of which, if we try to conceive its chemistry, this is obviously only a ludicrously inadequate summary—is accomplished in about the time you take to the inconceivably more wonderful feat of attaching ideas to the black marks which cover this paper.

SWIMMING

SYSTEMATICALLY and grandiosely named, this subject falls under two heads, those of flotation and of natation proper. It is possible, of course, to swim under water, but the first question to consider is how one's head may at all be kept above water; thereafter arises the further problem of locomotion.

The initial question is one of specific gravity, which we may call the relation of the mass of the body to its volume. A ship floats when the volume of water which she displaces by her presence is equal in mass—or we may say, in weight—to her own. The human body, as a whole, displaces a volume of water of less than its own weight, and therefore tends to sink. In other words, its specific gravity is higher than that of water: hence the problem of flotation. If we come to consider the various parts of the body, it is found that the head is the deciding factor. The rest of the body would float of itself. Not only is the head the heaviest part, but it is that which, from the necessity for respiration, must be kept above water. The more of the head that is submerged, the easier is the problem of flotation, water affording it far more support than air. The swimmer, therefore, will often plunge his head into the more buoyant medium, and thereby help to obviate the difficulty of its weight, besides utilising it as a prow.

But a fish is under the same imperative necessity to breathe as ourselves. It is not compelled to keep its heavy skull above water, because it can inspire the oxygen which is dissolved in the water itself. Even at the ocean bottom, two or five miles deep, it can obtain, in the Atlantic, oxygen which has been dissolved in the superficial waters of the pole—waters so cold that they sink as they travel to warmer latitudes and carry the life-sustaining element to the denizens of the "Deep's untrampled floor." The gills of the fish expose its blood to the oxygen-containing water, only a thin membrane intervening, and the gaseous interchange is thus accomplished, in precisely the same fashion as between the air and the blood in our lungs.

By the minimum of muscular exertion—less, of course, in sea-water, with its greater specific gravity, than in fresh water—the swimmer is enabled to remain near the surface. In identical fashion does the bird support itself in the air, though at the expenditure of far more muscular energy. And as the science of aeronautics has lately taught us, dirigibility and motor power are only attainable if the object be heavier than the supporting medium. M. Santos-Dumont will tell you that the only means of success in aerial navigation is the adoption of the "heavier-than-air" principle. Similarly in swimming. Little voluntary progress could be made—swimming would be practically impossible —if the human body were not heavier than water.

Before considering the muscular problem I should like for one moment to revert to the feat of swimming under water. I have not the latest records, but I believe one hundred yards have frequently been swum under water, and certainly more than four minutes have been spent under water without evil consequences. But it is quite useless to attempt the emulation of these feats unless you know the secret. If you desire to win a plate-diving competition by bringing up fifty or sixty plates from the bottom of a bath at one immersion, you must first acquaint yourself with an interesting physiological fact. It is possible to hyper-aerate the blood. Before diving you must take a number of long and rapidly succeeding breaths, far in excess of present need. Your blood is thereby stored with sufficient oxygen for several minutes, and, if you are active and have learned to keep your eyes open under water, you have a fair chance of victory. The same thing may easily be produced in an anæsthetised animal, by inflating its lungs with a pair of bellows. It will entirely cease to breathe for several minutes. There is simply no occasion. It is the production of this state, technically known as *apnœa*, which is the secret of successful long submersion.

The young of man, almost alone among animals, has to learn to swim. Nevertheless, he is at a great advantage as compared with such an animal as the dog, which has no such extended surface as the human hand wherewith to propel himself. A demonstration of this simple mechanical fact is well afforded by an exhibition of swimming with large plates strapped on the hands and feet, wherewith a single stroke will propel the swimmer for yards.

The act of swimming on the breast, as a feat of nervous co-ordination, is a simple one, for the obvious reason that it is symmetrical. Any pianist knows the difficulty—due to an asymmetry *of time*—in playing triplets with one hand and quavers with the other. So in all muscular action. In a symmetrical act such as swimming, the two halves of the brain act in entire unison, the left or "leading" cerebral hemisphere (in right-handed persons) actuating the right arm and leg, and simply saying to the right half, "Do as I do." This is assuming what is unproven but apparently probable, that the volitional centre is in the "leading" hemisphere. Why each half of the brain should control the opposite half of the body is another question. As for the various asymmetrical forms of swimming, they are so simple that they are learned as easily as the child learns to play different notes with two hands upon the piano. The asymmetry is one of space rather than time, and it is the latter that tends, very naturally, to dislocate the will, which is asked to duplicate itself in a manner which may be natural but certainly needs to be acquired.

One of the virtues of swimming is that it tends to develop all the useful muscles equally. Herein it is superior to cycling or Association football, which neglect the arms, to tennis, which ignores one arm and develops "tennis elbow" in the other, and even to cricket, which ignores the left arm except in batting. Not that for one moment do I desire to support the modern crazes which give appropriate exercises to develop every muscle—or every muscle known to the inventor—and which therein defy the fiat of evolution which is relegating some muscles, now useless, to a well-earned obscurity. The muscles of the foot were formerly indispensable to our arboreal ancestors, but are quite superfluous in a plantigrade-pedestrian mode of life. Swimming promotes the muscular development with some sense of proportion, but expends no time in raising absurd lumps of hypertrophied muscle — hideous and useless—in all sorts of out-of-the-way places.

But the chief virtue of swimming from an altruistic point of view is, of course, that it may enable the swimmer to save life. This is not the place, and still less is it the manner, in which to attempt a demonstration of the way in which a swimmer should approach a drowning person. But after the unfortunate is brought to land there often arises a question which is of too great practical importance to be omitted here. How most certainly may one resuscitate a person apparently drowned—that is to say, a person whose heart is still beating, but who has ceased to breathe? The whole question of artificial respiration has been experimentally studied at great length during the past two years or so by Professor Schäfer and his assistants in the physiological laboratories of the University of Edinburgh, at the instance of the Medico-Chirurgical Society of London. In a recent paper read before the Royal Society of Edinburgh Professor Schäfer has described the results of his experiments upon himself, his assistants, and some of the lower animals. In a chat with one of those assistants, Dr. Hunter, I learn that a new method has been discovered, simpler and safer than Sylvester's or Marshall Hall's or any other. It consists simply in placing the unfortunate person *on his face*—quite an innovation—and then rhythmically squeezing his chest. The attitude prevents the tongue from falling back and closing the entrance to the windpipe, and facilitates the running-out of the water which has probably entered the bronchial tubes. A supreme advantage of this method is that it may be successfully practised by a single unaided person. I seize the present opportunity of making the Schäfer method more generally known, since one never knows when the possession of this sort of knowledge may not indeed prove to be, as Spencer asserted long ago in defiance of the classicists, "the knowledge of most worth." I fancy it must feel very nice to have saved a life in such fashion. And perhaps I may just add the practical hint that, in any method of artificial respiration, one is very naturally apt to hurry in one's excitement and anxiety. The rate should be the natural one, about sixteen or eighteen respirations per minute. It is conveniently timed by one's own breathing—if that be not emotionally hurried.

The high value of swimming as an exercise is complicated by the exposure of the skin to a medium of much lower temperature than itself. Generally speaking, it may be laid down that the value of a sea-bath is in inverse proportion to its length. The shorter the dip, the more marked is the healthy reaction of the circulation and the cutaneous functions. Of course, one is rapidly losing heat to the water all the time, and beyond a certain point this is undesirable. (The hen is immune to anthrax; but stand a hen with its feet in cold water and then inoculate the bacilli. The hen will become infected.) If this loss of heat be compensated by the evolution of much heat as a result of muscular action, as in swimming, one can afford to stay in much longer. None of the salts of sea-water are absorbed. The skin is practically water-proof—one of its most important functions. (One hesitates to put down a thing so obvious—but I once met a man who did not know what his eyebrows were for, and he assured me that there are others.) It is not well to bathe after a heavy meal nor while perspiring; and cramp—muscular spasm induced by cold—may be avoided by not staying in too long. If you come out of your machine with blue lips and chattering jaws, you have done yourself more harm than good. The human supply of fat is not sufficient to be as effective a non-conductor of heat as is the blubber of the whale and the few other warm-blooded mammals whose ancestors were driven back to the sea—where all life began—by their competitors long ages ago.

SONG

THE physiology of singing is worthy of consideration, not only by teachers or exponents of that art, but by all who are interested in any form of music, since that early essay in which Herbert Spencer sought to trace the evolution of music from primitive song, which we may imagine to have been a sort of "recitative" speech, still stands as the most probable explanation of the origin of our most creative art, though much is also to be said for Darwin's converse view that speech is derived from song.

Over the human larynx itself, the mere motor machine, I am not going into raptures. Delicate though its construction be, man's voice-box, or "Adam's apple," is not the finest musical instrument we know. The entire arrangement, including the left half of the cerebrum of the brain (with which all right-handed people sing), is not to be paralleled anywhere; but the human larynx itself is surpassed in many of the lower animals. The birds, for instance, have an admirably contrived larynx that is quite as good as ours; but to this stringed or reeded instrument they add the syrinx, which is simply an organ-pipe. They have wind and strings in one. Nor am I going to discuss at length the evolution of the larynx, nor question why the "wise thrush" of April is always of the sterner sex. Suffice it that our organ of voice is the homologue of one of the gill arches of the fish, as our organ of hearing is a homologue of another. It is so; but we will wonder not less, but more, at the larynx of a Santley or a Jenny Lind, and the ear of a Hallé or a Richter, if we remember the base degrees by which they did ascend.

The vocal cords are made of fine, elastic tissue covered with a single layer of flattened but living cells. They are attached and fixed in front to the cartilage the projection of which is known as the "thrapple," or "Adam's apple."[1] Passing backward, they slightly diverge, each being attached to a movable nodule of cartilage behind. These posterior cartilages can be rotated by muscular action around a vertical axis, so that the glottis, or chink between the cords, may be obliterated or widened. This widening is the preliminary to every breath we draw, from the cradle to the grave. The singer takes such a breath. He then apposes his cords so that only a tiny chink is left. Thereupon he makes a forced expiration and drives a column of air against the resisting cords, which are thereby thrown into vibration. Now the pitch of the note produced depends upon the rate at which the cord vibrates. This, in its turn, depends upon the tension, length, and mass of the cords. The two latter factors vary in each of us. A man's larynx is larger than a woman's, his cords are longer and heavier, and therefore his voice is of lower pitch. But, excepting in the production of the falsetto, which is effected by an exceptional and imperfectly understood mechanism, each singer must accept his cords as they are. He can only affect their tension. This is done by tilting forward the front attachment of the cords, which raises the tension and therefore the pitch of the note; or by tilting forward the posterior attachment, which makes the cords slacker and the note more grave.

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[1] See illustration facing page 22.

The simple, unmodified laryngeal note—called by the teachers of singing the "naked tone"—is a hideous thing. It is utterly without resonance or emotional quality or beauty. It varies hardly at all in different people. The distinction between a note of given pitch, sounded on Caruso's larynx or mine, on a violin or a Jew's-harp, on the superb new organ at York Minster or a penny whistle, is a question of harmonics, "partials," or overtones. It is by these that we recognise which of our friends is speaking to us. All these overtones are potentially contained in the laryngeal note. No sound is actually produced elsewhere. But we use certain resonators which pick out and reinforce certain overtones and thereby give the voice its individual quality. If these overtones be numerous and well selected, so as to form definite musical intervals (such as the octave and the fifth), with the fundamental note, the voice is made rich and full and sweet. The teacher of singing is mainly concerned with the use of these resonators; but I believe the difference between voices to depend not so much on the anatomical form of the resonators (which probably shows less variation than is generally thought) as upon a difference in the ear—that is, in brain. Your strident singer likes strident tone, and produces it. Your De Reszke likes velvet tone and produces that—even at the cost of effect or ignorant applause. The resonators are the chest—which mainly reinforces the lower notes—and the cavities of the mouth and throat. To these we must add the air-containing spaces in the familiar bony projections behind the external ear and above the eyes. Every one knows that a child has no such frontal bosses, and that they are more prominent in a man than in a woman. All these cavities communicate with the mouth and throat, and so with the column of air which the larynx has already thrown into complex vibration.

Now all this is mere triviality beside the nervous action involved in singing. The pitch of every note depends upon muscular contraction which is determined by nervous impulses. Exactly in proportion to the strength of the nervous impulse the muscular contraction—and therefore the pitch of the resulting note—will be. Some idea of the fineness of gradation possible may be obtained by remembering the singer of last century who could sound eleven distinct notes between two consecutive notes on the piano—within a semitone, that is. And so we come to the crux of the matter, which is this: How is a singer enabled to strike a desired note? How is it that some are able to send exactly the right degree of nervous force to the laryngeal muscles, while others are doomed forever to send "the little less and what worlds away"—or, in other words, to sing flat? How is it that, as George Eliot has put it in *Adam Bede*, one may never sing in tune, and another, utterly untrained, may be "as true to his intervals as a lark"? (As a matter of fact, a lark has no real sense of intervals, but that does not matter. Browning alone was right:

> "We shall have the word
>   In a minor third
> There is none but the Cuckoo knows.")

And for the answer to this question we are thrown back upon "ear."

Now, "ear," in this sense, is in a well-defined area of the *cortex cerebri*, on the left side of the brain. We hear, of course, as we also see, on both sides; but sense of pitch is probably confined to the music centre on the left or "leading" side in right-handed people, just as the sense of colour is probably confined to the left side in such people; the facts, in each case, being reversed in left-handed people. The music centre is just in front of the hearing centre; by which I mean the centre for sound. That which understands the meanings of words is in another and distant part of the cortex, though also, of course, on the left side. Now, to be quite candid, I believe the music centre is all but non-existent in some of us. Nor can it necessarily be developed as, in every one but an idiot, the word-hearing centre can. And it is the music centre which controls and informs the whole act of singing, aided by what is known as the muscular sense. A recent Italian author has maintained—and he is probably right—that, in order to achieve a definite interval, as, for instance, from the dominant to the key note, the brain must receive an impression from the laryngeal muscles, which it couples with the sound received by the singer's own ear. These form an image of the desired interval in the music centre which determines the degree of nervous force necessary to cause precisely the degree of muscular contraction that will enable the singer to strike his new note true.

The muscular sense, or sensation received from muscles in action, is of such great importance in relation to our control of all muscular acts, from standing to violin-playing, and it is so important a factor in the production of those qualities which we call "eye" and "ear," that it might well have an essay to itself. At any rate, we may say that in the act of singing the muscular sense is displayed in its highest delicacy and precision. These latter qualities are the more remarkable if we recollect how extremely minute the laryngeal muscles are—so minute that only the most expert dissector can hope to display them. Yet it is the tiny nerve-endings upon certain fibres of these muscles which inform the brain as to their precise degree of contraction and thus help to make it realise the exact amount of nervous force which must be sent by it along the *motor* nerves to these same muscles, so as to effect exactly the interval desired by the composer. Two totally different sets of nerves, running between the larynx and the brain, are therefore involved, the one sensory, the other motor, but both indispensable.

As to the falsetto, so effective and beautiful when employed by a tenor of the first order, so painful when essayed by the amateur, we really know very little. Some half-century ago, Señor Manuel Garcia—who is enjoying his hundredth year as I write—invented the laryngoscope for the purpose of enabling him to study the physiology of singing. A great deal of the foregoing has been revealed to us by that invention, but, as a matter of fact, the instrument was soon abandoned by its maker, for it taught him very little, and left the question of the falsetto still unsolved. However, the medical profession soon adopted it, and has found it simply invaluable in the diagnosis of all sorts of disorders, not only of the larynx, but also of the brain and other parts whose condition may be indicated indirectly by the larynx owing to their nervous connection with it.

We might go further and attempt to discuss the immensely important question—from the standpoint of æsthetics—of the influence of varying emotion upon the laryngeal tone. Again, we might consider the various shades of tone which lie within the possibility of one voice; or that vain topic of the "vocal registers"; or the production of the vowels by modifying the overtones, or the formation of the consonants, or the phenomena of vocal compass, or of mere vocal power. To attack these questions one must first obtain some accurate ideas as to the nature of sound and the distinctions between a musical note and a noise, besides considering that microscopic replica of a piano in the inner ear, our knowledge of which, as of the "heat o' the sun," we owe to the omnivorous genius of Helmholtz.

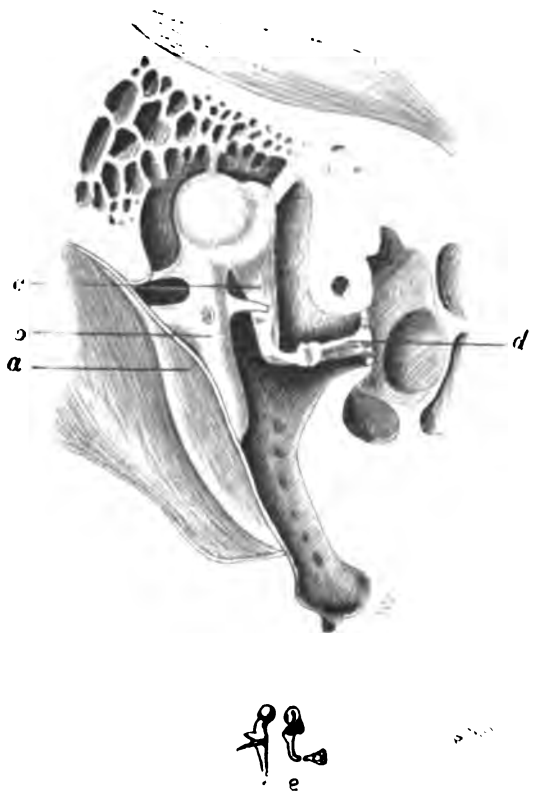
EARS TO HEAR

LET us conceive of an electron in an atom on the moon. It partakes of the following motions at any rate, and possibly more. It is moving within the atom; revolving, possibly, around an atomic centre. It is also partaking of that movement of the atom as a whole which constitutes what we call heat. It is also being drawn gradually towards the centre of the moon as she cools. It is also moving as the moon rotates upon her own axis. It is also moving as the moon revolves around the earth. It is also moving as the moon, with the earth, revolves around the sun. And, finally, it partakes of the motion of the solar system as a whole, which is journeying, at the rate of twelve miles a second, towards the bright star Vega in the constellation Lyra. Yet we recognise that the electron, simultaneously performing all these motions, is only moving in one direction in space at any given moment of time. The astronomer's mind recognises all these motions, yet he and we are agreed that, at any given moment, the electron is moving in one direction in space, and one only.

And in the human ear we have an organ which instantaneously, and without any exercise of the intellect, can similarly analyse a single motion, or series of motions, into components even more numerous, and that with a sensory gratification as keen as the intellectual satisfaction of the astronomer. Let us take an instance familiar to every opera-goer—the familiar trio in the last act of Gounod's "Faust." That which reaches the ear is a succession of aerial waves. At any given moment a wave of a certain definite form travels to the listener. The aerial particles, like the lunar electron which I have chosen as their parallel, are necessarily moving in only one given direction at any given moment. Yet in that single wave he that hath ears to hear may clearly hear, as if each were alone, the sound of the strings, or of the wind or the brass, or the percussion, or the voice of Marguerite, or the voice of Faust, or the voice of Mephistopheles. He can appreciate the wave as a whole, or he can pick out and observe or "apperceive" any one of these components and scrutinise its relation to the rest as if it were coming in at one ear and they at another. Similarly in a clamour of voices, resulting in a single wave-form, you may hear the whole, or fix the attention on one that is familiar, or, indeed, upon such overtones or harmonics in that particular voice as may indicate alarm or joy. Yet the aerial particles by which the whole is conveyed are moving each in only one direction at any given moment—only one complex wave reaches you. Or, to take another instance, Sir Charles Hallé, it is said, could detect in his orchestra the tone of a single violin that was out of tune, and could identify the player, presumably by the characteristic timbre of his particular instrument, even when a hundred instruments of many different kinds were combining to send a single wave to his ear. Two waves can never be simultaneously conveyed by one medium to the ear, since the atoms of air can only move in one direction at once.

Of all the marvellous powers of the human sensorium, this analytical, or, more properly, this reconstructive or recreative power of the ear is incomparably the most wonderful. Even in the case of sight, which ranks next to hearing, though far behind it, in acuity and in discrimination, there is not the slightest analogy. Gaze upon what you please, any given portion of the retina merely appreciates the ether waves, of certain rate and amplitude, which impinge upon it. You may, of course, gaze upon a landscape or a face as a whole, or fix your attention upon that part of your retina which receives the image of a particular tree or feature, but you exercise no analysis, as you do in reforming any component you please that enters into the formation of this single wave which, as a whole, enters your ear, though a Handel Festival chorus and orchestra be combined to form it.

If we look at a diagram of the form of a complex sound-wave, it is easy to see what is meant by using the term "reconstructive." That wave



THE MIDDLE EAR

CHAIN OF SMALL BONES OF THE EAR IN POSITION

a. Membrana tympani (drum of the ear).
b. Malleus attached to the tympanum.
c. Incus connecting malleus with stapes.
d. Stapes leading to inner ear.
e. Malleus, incus, and stapes, natural size (in position corresponding to above).

will consist of a number of ripples of varying size and shape, moulded upon bigger wavelets which, in their turn, are moulded upon waves bigger still. Each of the little ripples simply indicates all that is left of the wave produced by, say, a given flute or tenor, *when that wave has been merged in and blended with* all the other waves that are coming from the stage. Yet from a mere hint, such as an amputated curve in the whole complex vibration, the hearing ear can reconstruct, and imagine that it hears, the voice of any of the soloists, or the tone of any of the instruments in the orchestra.

Without pretending to explain this process, I may try to describe the mechanism through which hearing is effected. The aerial wave reaches, first of all, that practically useless appendage, serving even the most fortunate of us for little more than beauty, which, with characteristic emphasis on the superficial, we call the "ear." It is, of course, merely an arrangement for collecting and thereby intensifying the sound-wave. Though we possess three small muscles by which it may be moved, only very few persons can control them, and even they only do so by way of exhibiting an accomplishment. The external ear does not serve us, therefore, as it does a rabbit or a horse, as a means for determining the direction from which a sound proceeds. That we discover by comparing the intensity of the stimuli received by the two ears. Lord Rayleigh has spent much time and trouble in trying to help the physiologists to explain how we determine the direction of a sound, but he can offer no further explanation than that I have named. As a matter of fact, we are very easily deceived in this regard, as every one knows. The external ear is so shaped in man, furthermore, that it is practically useless as a collector of sound. From this mere ornament the sound-wave passes through a short canal which is closed by the tympanum, or drum of the ear.[1] To this drum is attached, on its inner side, a small bone, which is joined to another, and it, in turn, to a third; the three "auditory ossicles," as they are called, bridging across an air-filled cavity known as the middle ear. The air is supplied from the throat through the Eustachian tube; by which channel it may pass in or out, so that the pressure of the air may always be the same within and without the middle ear—a condition essential to our comfort. Two minute muscles are attached to these bones, so that if the one contracts, the "drum" is made tighter and the hearing more acute. This we use when we "strain to hear." The second muscle contracts so as to make the line of conduction less rigid, and is of value in opposite circumstances. If it be paralysed, loud sounds become very painful. The third little bone is fixed to another membrane which leads to the internal ear, and on the inside of which is a canal filled with fluid. The sound-vibration, having passed along the tripartite bony line of conduction, is conveyed to this fluid, which is con-

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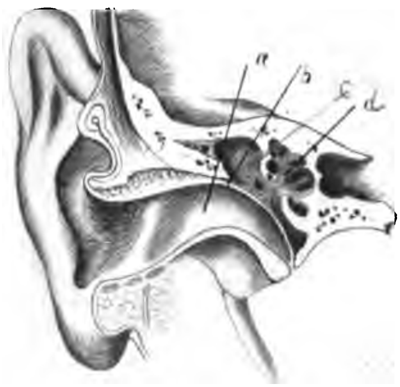
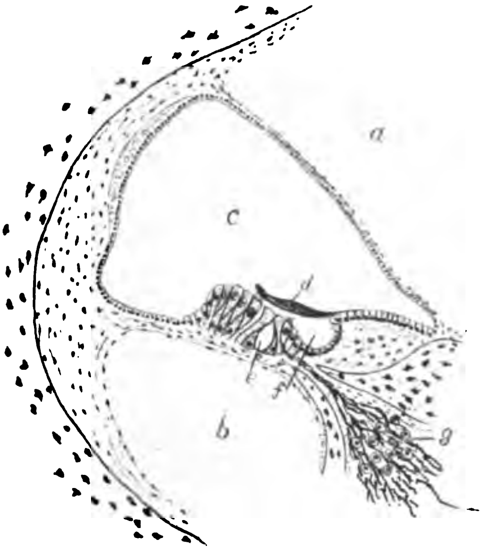
[1] See illustration facing this page.



a. The auditory canal
b Membrana tympani.
c. Middle ear.
d. Inner ear

FRONT VIEW OF THE ORGAN OF HEARING
With the chain of bones, semicircular canals, and cochlea removed.



a. Scala vestibuli
b. Scala tympani
c. Canal of the cochlea.
d. Membrana tectaria.
e. Terminal of Corti.
f. Spiral groove.
g. Auditory nerve with ganglion.

→ to brain

ORGAN OF CORTI IN THE COCHLEA
Seen on cutting across the spiral canal of the cochlea at any point.

tinued into a spiral canal called, from its shape, the cochlea. Stretched across the whole length of this spiral canal is a bridge—the organ of Corti[1]—upon which lies a series of delicate fibres of length steadily shortening as the canal, in its spiral turning, becomes narrower until it ends in an apex, like the house of a snail in miniature. Helmholtz supposed that, as in a piano, the shorter fibres (near the apex of the spiral) are for the high notes, and the longer for the low notes. Upon each of these fibres (numbering many thousands) lie a company of tiny living cells provided with minute sensitive hairs, ready to appreciate every motion or change of pressure which a sound-wave from outside may impart to the fluid in which they are bathed; while to the base of each of these cells runs a filament of the auditory nerve. The whole apparatus is perhaps twenty times as complicated as this slight description of its outlines would suggest. It is contained, on each side, within the hardest bone in the body, called, therefore, the petrous or rocky bone, and I would state the approximate size of the whole if I thought there was the least chance of being believed. The filaments of the auditory nerve are gathered together into one bundle and proceed to certain cells at the base of the brain. From these new nerve filaments start and travel to the "auditory centre," which consists of certain cells, arranged in about five layers, in the gray surface or

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[1] See illustration facing page 70.

"cortex" of the brain on each side, in a position which corresponds, more or less, to the part of one's skull just above the external ear. But the fibres have crossed over, so that the left side of the brain receives impressions gathered mainly from the right ear, and *vice versa.* The co-ordination of these sounds, however, rests mainly with the left side of the brain in right-handed persons, and *vice versa;* and on that side, in a special centre, is probably the seat of all musical appreciation. And lest all this should read as if a good deal were known of this matter, let me say that, of course, we have not the least idea how those hairy cells of the internal ear convert the vibrations of a fluid into nerve energy; that we cannot in the least discover what happens when an impulse passes along a nerve, and that no one has ever suggested a shred of an idea as to how the nerve cells of the gray cortex convert nerve impulses into consciousness of sound. Nor is there any known fact or theory which stands against the belief that even the simplest form of consciousness presents a problem utterly, essentially, and eternally insoluble.

DEXTERITY

BEFORE we toss off the glib assertion that all children should become ambidextrous, we must examine into possibilities. Here also it is necessary to begin at the beginning—at the brain rather than the thumb. The entire nervous system is bilateral, and should indeed, we may think, be symmetrical—there is a fine but all-important distinction. For if your brain be functionally an organ of bilateral symmetry, who shall decide when the two halves disagree? Two sovereigns on one throne cannot be each autonomous; in matrimony or war, or where you please, there must be, for success, an assertion—however phrased—of the principle of monarchy. Hence, as a matter of fact, one side of the brain must rule both. In right-handed people it is the left half that rules, and *vice versa.* The right half doubtless makes suggestions, just as one's "better half" may, but the left half rules. This apparent contradiction between the leading hand and the leading half of the brain is, of course, due to the fact that the nerve-fibres cross over in their passage from the brain to the rest of the body. Perhaps the first question that arises is, how is it determined which is to be the "leading half" of the brain and which the "led"? There have been such reasons assigned as that, the vulnerable heart being on the left side, the left arm is naturally employed in its defence, a rôle more passive than that of the right arm, which is dedicated to offence, and subsequently to an infinity of various purposes. But many explanations have been brought forward and discussed in a dozen places, so we may leave this question by suggesting that the factor which determines whether one shall be right-handed or left-handed—whether, that is to say, one shall be left-brained or right-brained—may, perhaps, be found, as seems reasonable, in the conditions of the growing brain itself. There is a difference in the arrangement of the arteries which go to the two sides of the head. This difference is usually in favour of the left side, where, as a matter of anatomical fact, the arterial arrangement is simpler. The left half of the skull may therefore, as a rule, develop more rapidly, and gain an early ascendency over the tardier right half. This, of course, is neither fact nor theory, but hypothesis. The commingling of individual speculation with established truth is excusable only if it be plainly stated to which category each clause belongs.

Let us take it, then, that in a given brain the left is the leading half — the owner is right-handed. Certain obvious consequences follow. He will hold a knife in his right hand. Learning the piano, he will make more rapid progress with his right hand. (The treble containing as a rule the melody, and usually the part which requires more skilful execution, it is the right hand, of course, which is most naturally responsible for it. Were the majority of people left-handed, pianos and organs would be made with the lowest notes on the right of the key-board and the highest on the left.) Then, again, the right-handed foot-baller, being really left-brained, naturally prefers to kick for choice with the leading half of his brain, or, in other words, with his right foot; so that a judicious committee in selecting an International Rugby team will choose a right-handed foot-baller to play "left three-quarter," because his right leg, his best, is in that position most favourably placed for "finding touch" when he "punts"; while a left-handed player would similarly be put on the "right wing." This terminology is a little obscure, perhaps, but in talking about games every one has to be abstruse.

But besides the obvious consequences of being right-handed there are many which seem less necessary. One probably distinguishes, for instance, between Beethoven and Wagner by means of the music centre, which is in the left half of the cerebrum in right-handed persons, and *vice versa*. The same is probably true of the appreciation of colour, which is probably mainly accomplished by that half of the vision centre which is placed in the left cerebral hemisphere. Nor is this nearly all. If you are right-handed you accomplish the translation of these marks into "words" and attach ideas to them by means of the left half of your brain. When you are spoken to, it is similarly the left half of your brain that understands. When you speak—and, for that matter, when you sing—it is the left half of your brain that gives you the words or the notes. When you write, it is the left half on which you depend. And I may note that if you try to write with your left hand, it is indeed the right half of the brain which is *driving* the left hand, but the left half of the brain, all the time, is guiding and directing the entire process. If by accident the writing centre be damaged, one cannot write with either hand—one has simply no idea what marks to make. The leading half of the brain, to sum up, is the seat of the speech centre, the writing centre, the word-hearing centre, and the word-seeing centre—word-comprehending would be the better term, for the hearing and seeing are done by either half, the comprehension by only one.[1] A digression into medicine for an illustration: If the speech centre be thrown out of action, as often in apoplexy, by the rupture of the single tiny artery which supplies it, one can still articulate, but unintelligibly. A few simple words, however, seem usually to be learned by both halves of the brain. A person thus stricken is, therefore, often able to employ "yes," "no," "please," in the right fashion, and, in the

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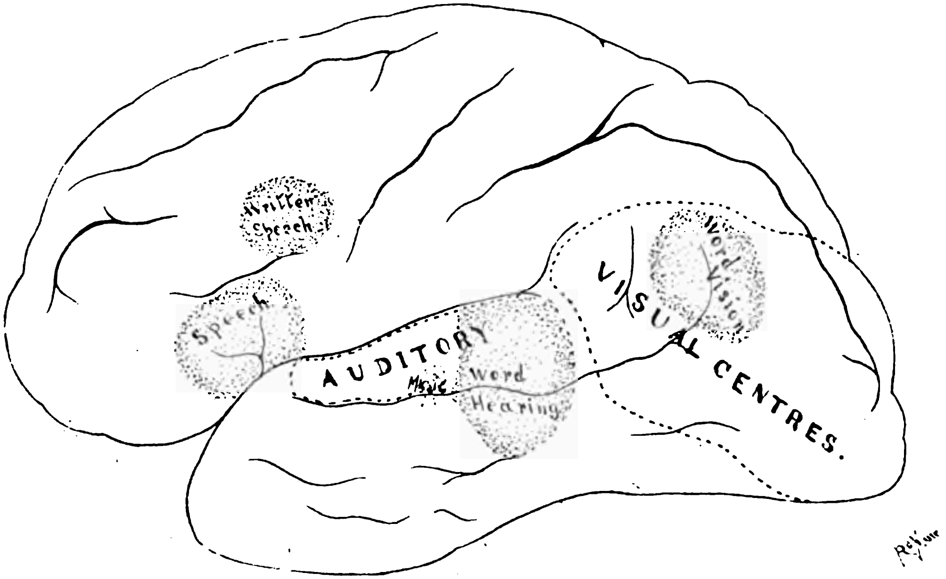
[1] See illustration facing this page.



CHIEF CENTRES OF LEFT HEMISPHERE OF THE BRAIN IN A RIGHT-HANDED PERSON

case of the expletively inclined, certain familiar ejaculations, so often used as to have "trickled over" to the right side, are also retained. They may, indeed, constitute the sole remaining vocabulary, so that the unfortunate person's conversational powers are entirely confined to monosyllabic and irrelevant references to such theological dogmas as need not be further defined. Such a person, with nothing to say for himself but "——" and "——," presents a spectacle only too ludicrous and lamentable.

But though the led half is so meagrely equipped, much may be made of it if the leading half has been damaged. One remembers a little right-handed girl whose speech centre at the age of four years had been incapacitated beyond repair. The child consequently lost her small vocabulary, but began again with the uninjured side, and went through the "mamma" stage and its successors so rapidly that in a year or two she had made up all her lost ground. There is no inherent weakness in the "led" half; the arrangement is one of economy and convenience.

A large number of fibres cross over from one side of the brain to the other and connect the gray matter on either side. Certain of the cells of the cortex—the gray surface—are indeed devoted to this purpose, and send fibres which terminate around the cells on the other side. In rare cases these connecting or "commissural" fibres are not formed, the "corpus callosum," which they compose, being entirely absent. Curious consequences may follow; but they raise problems further than can be here pursued. From an apparently simple question of domestic education, often carelessly discussed and decided upon, we pass, ere we know it, to the consideration of facts which lead us to the threshold of the problem of personality; but lest any should think that the double form of the brain is the key to cases of double personality, or to the ever-instant problem of the "better self," and its conflict with the worse, let him inquire whether anatomy, as here adumbrated, can explain cases where six, seven, or more personalities are displayed in an individual; and when this question is solved, there will remain many more, beside which it is a bagatelle.

But recognising, as we do, that the supremacy of one side of the brain is apparently an inevitable, if not desirable, economy, we need by no means discourage such attempts as those made by the Ambidextral Culture Society recently formed in Great Britain. On the contrary, we must recognise that the hand is largely the tutor of the brain—as Professor Michael Sadler has lately reasserted—and should therefore encourage the use of both hands as far as possible. In his epoch-making *Principles of Psychology*, just short of half a century ago, Spencer showed how all our senses are really evolved from that of touch—a truth dimly guessed by the astonishing genius of Democritus more than twenty-three centuries ago. Let us, therefore.

for the sake of the growing brain, earnestly support all attempts at the encouragement of ambidexterity in education, while at the same time remembering that there is at present, at any rate, very little sign of our being able to produce "ambidextrous" brains.

THE EVOLUTION OF SENSE

THE curious sense of internal sinking which follows the perception of the fact that the printer has credited one with a misprint implying inexcusable ignorance or carelessness may be used as a measure of the path followed by the evolution of sense. The amœba is a relation of mine, and is endowed with sensation; but, were he to crawl over that badly misspelled word, the substitution of one letter for another would cause him little or no perturbation. His sensory powers would possibly acquaint him of the nutritious iron in the ink wherewith the word is printed, but that would be all. Similarly, the amœba may well be dimly aware of the aerial vibration which we term sound, but he is appreciably removed from the opera-goer who thrills at the ecstatic agony of Isolde's "Liebestod," and still further from the sensory development of the genius who conceived that deathless song. Sensation, indeed, has travelled far in its development from the mere reaction to external stimuli, exhibited by the amœba or the microbe, up to the literary sense, or the "sense of the fitness of things," or the "moral sense," or any of those precious potentialities of the true sense of beauty which constitute the subject-matter of the science of æsthetics.

Let us then look at sensation, or the power of appreciating external forces, as we find it in the lowest forms of life. We will take, instead of an amœba, a white-blood cell, or leucocyte, which is hardly distinguishable from an amœba. If, under the microscope, you watch a leucocyte in a drop of blood making play with a microbe, you have an opportunity of studying the simplest form of sensation. It is partly physical, partly chemical, and therefore may be compared to a sort of compound of touch and smell. The force which determines what will happen in such a duel has been called chemotaxis. If immunity has been established by some method or another; if, for instance, the patient from whom your drop of blood has been obtained is recovering, the leucocyte's sensation is described as a state of "positive chemotaxis." Not only is he aware of the presence of the microbe, but he responds by attacking, enveloping, digesting, and thus disposing of it. If, on the other hand, the patient is having the worst of the battle, the leucocyte is aware of the microbe indeed, but is repelled rather than attracted; the condition being known as one of "negative chemotaxis." In other cases a leucocyte may approach a microbe, having become conscious of its presence by this rudimentary physico-chemical sense, but may then discover that its foeman is more than worthy of its steel, and will retire—with inaudible apologies. It is said that, in such a case, the leucocyte may return later, with a couple of friends, and engineer a tripartite attack—but this I have not seen.

Now, the leucocyte or the amœba, being unicellular, is complete in himself. He is all sensory, as he is all motor and all digestive and all reproductive. But in multi-cellular organisms, such as we become, a "physiological division of labor"—to use the admirable phrase invented by Henri Milne-Edwards—is effected. Certain cells become segregated for the sensory functions of the organism; and these are naturally the superficial or external cells. Very low in the animal scale we find a definite division of the body cells into external and internal. The former are known as the epiblast, the latter as the hypoblast. Between the two there appears, in slightly higher forms, a collection of cells called the mesoblast, from which our bones and muscles, for instance, are developed. But I want especially to consider the epiblast, which is by far the most interesting of the three layers of the primitive blastoderm, as it is called.[1] Being external, it is, of course, the layer that assumes sensory functions. Its powers are very limited in the simple animals, being hardly more differentiated, indeed, than are those of the amœba or the white cell of the blood of higher animals. But if we pass to such an animal—and we may consider man him-

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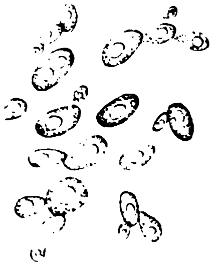
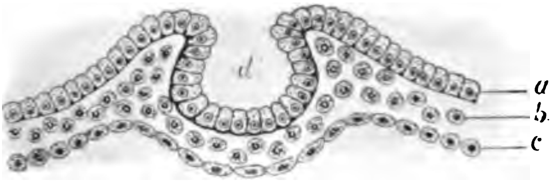
[1] See illustration facing this page.



YEAST CELLS

Saccharomyces cerevisiæ.



TRANSVERSE SECTION OF A BLASTODERM

a. Epiblast. *b*. Mesoblast. *c*. Hypoblast

d. Neural groove (shortly to become a canal lined with epiblast).

self—we are not surprised to find that the epiblast, or external layer of cells of the human embryo, forms, among other things, the skin. The cells of the skin are, of course, the most external, and could not be developed from either of the other two primitive layers. And, of course, the skin, like the epiblast from which it is developed, and like the epiblastic layer of the adult forms of simpler animals, is a sensitive structure. The sense of touch, the sense of pain, the sense of temperature all find in the skin their means of receiving external stimuli. Than this chapter in the embryology and evolution of sense nothing could be more natural.

But if we observe the embryo at a very early stage of its development, we find upon its surface a longitudinal ridge where the epiblastic cells become especially numerous. This ridge becomes a groove, and by a process of infolding of this groove —which the diagram makes obvious, but which it is difficult to describe in words—certain of the cells of the epiblast lose their original external position and sink into the substance of the embryo, so that some of the cells of the mesoblast or middle layer come to separate these particular epiblastic cells from their fellows which remain on the surface. These buried cells, for whom is an incomparable destiny, are called the neural or nerve epiblast, for from them are formed the brain and the entire nervous system of man, from them is developed the gray matter of the surface of that brain, and in it is manifested consciousness, which makes possible all other phenomena—religion, science, history, art, and thought.

Now the significant thing is this: that the entire nervous system is developed, so to speak, from the skin. Its cells are originally superficial and external, but are withdrawn from the surface to the centre of the organism. In the case of an animal that has no nervous system proper, the external surface—its "skin"—is the sensitive portion; is, indeed, its nervous system. The higher animal, very early in its history, withdraws part of its primitive skin, encloses and protects this part in the skull and spinal column (developed from the mesoblast), and is enabled to develop it to a degree previously unattainable and barely—even by its possessors—conceivable.

Now we have gone so far as to consider the original epiblast divided into two portions—the cutaneous epiblast, which remains external, and the nerve-epiblast, which has passed inward. This nerve-epiblast is essentially sensory, as is the cutaneous epiblast from which it has parted company. But if it is sensory, it must needs re-establish communication with the surface of the body, where stimuli are received. A vision centre in the brain is of no value unless there be eyes at the surface. So by an extremely complex series of processes the nerve-epiblast contrives to send back emissaries or nerves to the surface whence it came; and upon the ends of these nerves, which are in themselves useless, are formed "end-organs." Such end-organs are the eye, the ear, the olfactory mucous membrane in the nose, the taste-bulbs on the tongue, and the touch-bulbs in the skin. The entire apparatus is formed of nothing but epiblast—of nothing but the original external layer of the embryo. I cannot insist too much upon this fact, for its significance is extreme. The manner in which the reunion between the nerve-epiblast and the cutaneous epiblast is effected varies within wide limits. In the case of the eye, for instance, the systematic zoologist will tell you that one of the features which distinguish the vertebrates from the invertebrates is that in the latter the essential parts of the eye are formed from the skin, to which the brain—or developing nerve-epiblast—merely sends forth the optic nerve; whereas in the vertebrates, whose eye is a much more highly developed organ, the cutaneous epiblast contributes hardly more than the covering of the eyelids, while the brain itself develops a special bulblike portion which it advances upon a stalk—the bulb becoming the eye, and the stalk the optic nerve.

The entire nervous system is thus primarily a receiving apparatus, a means of sensation, developed, indeed, from the very surface of the body. As it exists in the adult human frame it constitutes the supreme object of scientific study. The tendency to glorify one branch of science at the expense of another is on the highway to specialism in the worst sense of the term, and ends in unenlightened fanaticism; but it is permissible to assert that the study of the human nervous system—call it neurology, psychology, "cerebral biology" with Comte, or by whatever name you please—has a fascination and a value that are transcendent. For in consciousness, the root-problem of psychology, and in the nervous apparatus of which consciousness is the chief function, are the possibility of any knowledge whatsoever, are the roots of the science of logic, which is our indispensable instrument of thought, and are the foundations of the two highest sciences of all, those twins of so deep a mutual indebtedness, sociology and ethics.

This theory of the evolution of the nervous system—the apparatus of the human mind—from the undifferentiated surface of a single cell, which each of us once was and from examples of which, in the distant past, all living things have been evolved, lies at the very foundation—is, indeed, the actual foundation—of contemporary psychology. Upon this conception, which, in accordance with the law generally but mistakenly named after Von Baer, applies equally to the history of the individual and the history of the race, all our modern theories of the emotions, the will, and so forth are based. The reader who cares to go to the fountain-head for the first and final enunciation of this great conception will find it in the *Principles of Psychology*, where it first saw the light in the year 1855: half-way through that ever-memorable decade which gave us the first-fruits of the genius of the apostle of evolution, and, thereafter, the masterpieces of Alexander Bain, and, finally, in 1859, the *Origin of Species*, in which one method of evolution in the particular sphere of organic matter was so admirably demonstrated.

THE VERDICT OF SCIENCE UPON ALCOHOL

In the early part of the year 1904 there was sent out to every registered medical practitioner in Great Britain a copy of a petition to be presented to the Central Educational authorities of this country, in which it is asserted that "a widespread ignorance prevails concerning not only the nature and properties of this substance"—that is, alcohol —"but also its effects on the body and the mind." The petition urges that instruction be given to our school-children in this matter, as it is already in army schools in Canada, in Victoria, South Australia, Natal, Canada, and the United States, to mention English-speaking countries alone. Within four days of the posting of this petition *fourteen thousand signatures* were received. But if there be a "widespread ignorance" on this matter, and if such unanimity upon the facts as these figures indicate has really been arrived at, we may find it worth while to consider what the facts really are.

The verdict of science upon alcohol is that it is a poison to protoplasm—the "physical basis of life"; but at the same time almost every scientific physician is prepared to admit that, even apart from hat-making and motor-cars, alcohol has its uses for man. But public opinion would assuredly be greatly surprised if it were to take up and read in any modern text-book of pharmacology or therapeutics what is the actual verdict of physiological and medical science on the uses of alcohol.

To discover that what is taken to "keep out the cold" markedly and consistently lowers the temperature, and that the indispensable "stimulant" is often administered as a sedative, would abolish the absurdity to which most people must apparently give credence, that alcohol is invaluable to the doctor and yet fills our hospitals and asylums. There is in reality no contradiction, and the position taken by the three official representatives (all of whom use alcohol in their practice) of the first medical school in this country in signing the recent manifesto is capable of an inexpugnable defence on purely scientific grounds.

If ethyl alcohol were for the first time presented to a biologist, together with an account of its origin, he would expect the substance to have certain poisonous properties and would put it down, provisionally, as among the toxins. Countless simple plants, such as the bacilli of tuberculosis or diphtheria, produce characteristic poisonous substances, or toxins, which can be more or less definitely isolated and studied. Alcohol, in a word, is the toxin of the yeast plant.[1]

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[1] See illustration facing p. 82.

Examined chemically, it is found to have a comparatively simple constitution, represented by the formula C_2H_6O, which states that each molecule of the substance contains two atoms of carbon, six of hydrogen, and one of oxygen. Now each atom of carbon has a natural affinity for two of oxygen—as in carbonic acid, CO_2—while every two atoms of hydrogen desire one of oxygen—as in water, H_2O. It therefore follows that alcohol will burn — will combine with oxygen. If it burns, it is a source of energy, as in a motor-car. If it burns within the body, it will produce energy for us—in other words, it will be a food. And if erroneous statements have been made in any branch of human knowledge, it is on this point.

Alcohol contains no nitrogen. It therefore can never and does never produce tissue. Its food-value depends exclusively on its production of energy; and the first indisputable fact is that alcohol can be burned within the body. It may, therefore, be a food; and in fevers it is probably the most valuable food that can be given to a patient, for in fever one cannot digest, and alcohol needs no digestion. It is, so to speak, a pre-digested food, and passes unchanged to the tissues, there at once to be utilised. What are the facts in health?

It has been experimentally proved, not once but often, not in one country or continent, but in physiological laboratories all over the world, that in health only about one and a half ounces of absolute alcohol can be burned within the body each day, this obtaining only when the substance is taken in sufficient dilution and at sufficiently numerous intervals. Approximately, three ounces of whiskey or brandy, taken in four-hourly doses of half an ounce, well diluted, is all that the average man of normal temperature can utilise. Heat your furnace—raise the body temperature as in fever—and, fortunately, much more can be burned—as much as would make a healthy man completely intoxicated; but at the normal temperature of the body alcohol can be used, under the most favourable conditions, only at the rate of an ounce and a half per day. Its characteristics as a food, *in health*, are its quite outrageous price, and the fact that, unlike other foods, this product of the fungi ultimately leads to morbid changes in practically every cell of the body, but most especially in the nervous system, where it can often be detected after death, though there is no trace of its presence elsewhere.

As a "stimulant" alcohol purports to belong to the same benevolent class as light and air, which are the best and cheapest stimulants in the world In the narrower sense, it must be classed with tea, coffee, cocoa (which is a useful stimulant with very slight food-value), tobacco, and opium. One might as well inveigh against civilization as against these, but it is worth while to point to one or two differences which are the common knowledge of all students of pharmacology, and, like all the foregoing facts (except that as to the utility of alcohol in certain fevers), are not in dispute. Of these drugs the two worst are, of course, alcohol and opium, but there is this distinction, much enforced by Sir Thomas Fraser, of Edinburgh, who is not a teetotaller, and than whom there is no greater living authority. It is impossible to detect any morbid tissue-changes from the use of opium. Opium-smoking produces certain evils which, it is now admitted, have been greatly exaggerated. Habitual hypodermic injection of morphia produces much greater evils, but neither leaves any physical traces, whereas the cloven hoof of alcohol may be traced with the naked eye and with the microscope in all the important organs of the body, especially in the digestive and nervous and circulatory systems.

And another interesting distinction—one cannot enter into all—is the action of these substances on the heart. Every one of them, especially coffee, is a cardiac stimulant. But alcohol is properly a pseudo-stimulant, and there is reason to believe that its action may be regarded as the first desperate protest of the heart muscle against the poison which ultimately overpowers it. The stimulation of alcohol is invariably followed by a *quid pro quo* in the form of a corresponding subsequent depression.

How does it come about that so many of us take alcohol to keep out the cold? Simply because the nerves of our sense of temperature end in the skin. Be our skin well supplied with warm blood, we say we are warm; and *vice versa.* Furthermore, we normally *lose* heat, and keep our temperature at the proper level, by radiation from the skin. Any drug that dilates the blood-vessels of the skin will therefore tend to make us *feel* warmer and *be* colder. Every one is aware that alcohol dilates the cutaneous blood-vessels, as in the drunkard's nose; they do not know that the consequent loss of heat is a devitalising agent that is often a predisposing cause of pneumonia. You can do nothing more foolish than take a nip of whiskey before going out on a frosty night.

Infinitely more important than all these considerations is the action of alcohol on the nervous system. In an essay which purports to describe merely the normal action of alcohol on the healthy body, I have no business with the records of insanity or crime, but it is worth while to dispel another popular error as to the influence of alcohol on the mental processes. For many years now this has been a subject of exhaustive inquiry in the psychological laboratories of Germany, France, and America. The conclusions reached are extremely remarkable. Numberless tests have been carried out with such processes as adding up a column of figures, writing an account of a simple occurrence, discriminating between colors, and so forth. And the singular result, well established and confirmed, is that alcohol delays the rapidity and impairs the accuracy of these processes while producing the most convincing illusion of ease and rapidity. The calculator has a subjective impression of facility which the cold clock entirely fails to confirm. This fact has not yet been explained, but our knowledge of the chemistry of brain-processes tends to show that the alcohol molecule undergoes the most complex relationships with the protoplasm of the living cell. In the light of these exact researches, the medical profession is compelled to admit that there is a terrible charge at its door. We have banned wines because of their relation to gout, and have thereby produced far greater evils in the increased demand for spirits. We have not protested, as we should have done, against the use of raw spirits, which contain such deadly nerve-poisons as amyl alcohol. We have not thrown the weight of such authority as we may possess into the scale against the opinions which are now admitted by all students of the subject to be erroneous. But the tide has turned. Arraigned before the bar of science, which nowadays can try whatever case it pleases, alcohol has been found guilty: the judges are physiology, pathology, pharmacology, clinical medicine, psychiatry, and criminology. But though they concur in their verdict, society alone can pass sentence.

SAVIOUR OF COUNTLESS LIVES

WHO, then, is this Lord Lister, whom the press discovers and paragraphs every now and again, and of whom it has been said that he "saves more lives every year than Napoleon took in all his wars"? With the great men of the time, who make and break and unmake our "laws," we are, of course, being well-informed persons, familiar; but not one in a thousand of those who owe their lives or their limbs or their friends to Lord Lister has ever heard his name. Wherever modern surgery is known, there they are, from Edward VII. to the nameless aboriginal treated at a missionary hospital in Hong-Kong or Uganda. Last year there were about fifteen thousand operations for appendicitis alone in Great Britain, of which ninety per cent. were successful; and that percentage is yearly rising. Thirty years ago one patient of three who submitted to a surgical operation died therefrom; now the figure is less than one in thirty, though operations are performed every day which would have been criminal three decades ago. At that time a surgical operation was a great event. The great operating theatre in the Royal Infirmary of

Edinburgh, where some of the first abdominal operations were performed, will seat six or seven hundred people. The latest of the ten tiny operating theatres which replace that one to-day will hold eight spectators at a pinch, and not one may enter without special permission from the surgeon. And yet students see far more operations than they did before, for so many more are performed. Of last year's patients in London hospitals forty-one per cent. were surgical as against thirty odd that were medical. Thirty years ago the penalty of the supreme function of maternity was that a woman had a less "expectation of life" than a man. Now, by the application of the Listerian or antiseptic method to obstetrics, the reverse is the fact. Oliver Wendell Holmes, Professor of Anatomy at Harvard, writer of the stanza beginning "Build thee more stately mansions, O my soul," and doer of many more things worth doing, was among the first to declare that "puerperal fever" was not a specific thing, like scarlet or typhoid fever. So did poor Semmelweis, who might have won Lister's imperishable fame had he employed, as Lister did, the scientific or experimental method. Nowadays puerperal fever means sepsis; surgical fever means sepsis; and sepsis is one common process the world over, as antisepsis or asepsis or Listerism is its one common remedy.

The law of continuity applies to great discoveries as to the rest of phenomena. Lister did not spring up and conceive antiseptic surgery *ex nihilo*. First

LORD LISTER

came the discovery that yeast was a living thing. This proved the existence of minute forms of life, and connected fermentation with vital processes—for the grape-juice is the product of a living plant, and the change from the glucose, or grape-sugar, to alcohol, and later to acetic acid, or vinegar, is also due to minute and living plants. Then came Pasteur. The accepted doctrine was that suppuration was due to the oxygen of the air. Public belief on scientific matters represents, roughly speaking, a distorted version of the scientific belief of half a century before; so if a child cuts its finger the maternal admonition still is to put on a bit of sticking-plaster and "keep the air away from it." But the great French chemist became infatuated, as people thought, with certain minute living things which he had discovered. He was told that he would do wisely in returning to chemistry, in which he had already made a great name. But he preferred to solve this question of suppuration, and proved by experiment that "microbes" (his own excellent term), or "germs," or "micro-organisms," or "bacteria," are the cause of suppuration, which is as truly a fermentation as the processes initiated by yeast. "Thus," in Lister's own words, "was presented a new problem: not to exclude oxygen from the wounds, which was impossible, but to protect them from the living causes of decomposition. . . . To apply that principle has been my chief life-work." And one need hardly say that the application of that principle is not limited to the major operations of surgery, but is employed in every hospital and every practice all the world over, for the quick and safe healing of legions of injuries, "casualties," and minor operations.

When Lister began, he believed that the microbes were in the air, and he invented a "carbolic-acid spray," which was used to disinfect the air in the neighborhood of the wound. I well remember the theatre where—long before my time—this spray was used, and the accounts of a certain occasion when the thing broke and the carbolic acid ran along a familiar passage, and Lister made a few pertinent remarks on the unfortunate clerk in charge of it. But those were early days, and Lister's methods soon underwent modification. The microbes are not, generally speaking, in the air, but in the skin and on all other surfaces. "Imagine yourself and everything else covered with green paint," said Lister. So the spray was abandoned. Lister's solutions of carbolic acid were far too strong at first, and, as they were weakened, the results, and the arguments based upon them, became more striking; for carbolic acid and other antiseptics are deleterious to living cells generally — though in varying degree — and weaken the patient's tissues and diminish their healing power, besides destroying the germs that may be there. Hence the celebrated remark of *The Times*, which must have seemed very apposite, seeing that the use of these solutions was the essence of Mr.

Lister's claim: "Mr. Lister's arguments are getting stronger as his solutions get weaker!"

The weakness of the solutions has now reached vanishing-point in the aseptic method, which is the final form of Listerism. Yet I have heard an anti-vivisector—who had doubtless profited in many ways himself by Listerism—infer from Lister's recent words on the aseptic method that he himself had abandoned antiseptic surgery as a myth. Let me try in a few words to indicate the technique of the new method: As Lister showed long ago, antiseptics are in themselves a danger to the patient. Every one knows that carbolic acid is poisonous, and one of the indirect results of Listerism is that suicide by this poison has greatly increased of late years—it being, indeed, one of the three most often employed—since it is now so readily accessible. Aseptic surgery maintains that no atom of any antiseptic is to touch the patient. Only "salt solution" of blood-temperature, or "normal saline" (so called because it contains the exact percentage of salt which occurs in the blood, and is therefore the only *absolutely* non-irritant substance known), is ever applied to the patient's tissues, except where microbes are already present; in cases of "unbroken skin" (where microbes cannot have entered) nothing else is used. But observe where the principle comes in. Every instrument is boiled. Every towel and cloth is boiled. The whole theatre is rubbed down with carbolic acid or other antiseptic. The table is similarly treated. The patient's skin is similarly treated for forty-eight hours before operation, but when the time comes the now unnecessary antiseptic, which has already done its work, is carefully washed away with normal saline. The surgeon's hands are subjected to a complicated series of processes—which render the skin highly unfitted for subsequent piano-playing—and the aseptic method says, in a word, that all microbes are removed before operation, and that none will be admitted during or after it. The same technique is followed in every maternity hospital. The responsibility of the surgeon is now terrible, and personally I look with astonishment upon all who face it. He has the operation itself and the risk from the anæsthetic to consider, and for three days afterwards he has the consciousness that if a single step went wrong in the technique—if an assisting nurse put a finger-tip to her hair, for instance, or if he himself had inadvertently adjusted his eye-glasses or otherwise touched a non-sterilised surface—the patient may die, and the death be not a "dispensation of Providence"—which formerly killed the women in maternity hospitals—but a theoretically preventable failure in the most complicated and difficult and responsible technique under heaven — violin - playing and billiards included.

Yet so perfect has the surgeon's technique become in these days that there is hardly anything which he fears to face. No better instance could be taken than that of an operation which saves two lives. Of course, this may be said of any case in which life is saved after a murderous assault, for not merely the patient, but also the would-be murderer is thereby spared to society. But surgery can otherwise save two lives by one operation, in the various forms of what is known as Cæsarean section—it being reputed that Julius Cæsar was by this means brought into the world. Suffice it to say that the operation—formerly an extreme measure which almost necessarily meant the death of the mother—has now in several instances been performed three times successfully upon the same patient. The adverb is meant to imply that the operation was in each case injurious neither to the mother nor to the child. Only a very few years ago it was the orthodox practice so to perform the operation that no one might have to undergo it twice. Nowadays, certain of the perfection of his antiseptic technique, the skilled operator surveys with equanimity the prospect of an indefinite number of occasions on which the same patient may avail herself and her unborn child of his skill.

Listerism began about thirty years ago in Edinburgh. Remembering the recent discovery of radium as an unsuspected source of terrestrial heat, I hesitate to say how many millions of years it has yet to run.

FRATRICIDE

In writing an essay upon influenza we are very far away from exact science, and are embarked upon deep and uncertain waters. No far extension of a nice exactitude is possible in discussing, even from the academic stand-point, a battle waged between the highest and the lowest forms of living matter. Such is this: man, the highest representative of animal life, fights with a unicellular plant of the simplest and most elemental form; and, with an eye to the combatant with whom are our sympathies, we call the conflict influenza. The issue, however, rests more directly with the influence of the animal upon the invading plant than with the influence of the plant upon the animal, though to any one but the bacteriologist such a statement may appear to be hardly so much a paradox as an actual absurdity.

Perhaps one may demonstrate that science recognises this domestic fray by giving its weapons the semblance, at least, of mathematical form. Thirty years ago there was not a printed page upon bacteriology in the British Museum. To-day there are upon its shelves more than four hundred volumes dealing exclusively with that vastly important science. Of these almost the very latest contains an equation which concerns influenza and every other bacterial disease. It runs thus:

$$D = \frac{MVN}{R}$$

Now it would be idle to pretend that a science which deals with the interaction of hostile forms of life—forms, too, so mutually remote in structure and activity—can ever become exact. Yet this equation represents some approximation to theoretical exactness. D, the disease, equals M, the micro-organism (or "germ"), multiplied by V, its virulence, multiplied by N, its number; the product being divided by R, the resistance of the individual attacked. The analogy is obvious, of course, to Ohm's familiar law, represented by the equation

$$C = \frac{E}{R}$$

—the current equals the electromotive force divided by the resistance. If one realises the plane of complexity with which the bacteriological "equation" deals, one will recognise how valuable is an expression of the case which represents any parallel, however distant, to such a simple affair of physics as the law of Ohm.

All this may well appear unrelated to the silly nonsense of current print about influenza. Nor is my right to deal with influenza as a scientific subject in any way supported by popular parley. Such absurd phrases as "a touch of influenza," "an influenza cold," and the like, are so far from having any relation to science or "systematised knowledge" as to appear rather to form part of some too superfluous scheme for systematising ignorance. Furthermore, it is supposed that a real grasp of the subject of influenza is obtainable from such a source as the history of its name. To know that the Italians call it "influenza" in allusion to some supposed malign supernatural influence, and that the French call it "la grippe" in a spirit of more immediate metaphor, and that its titular patronymic is "Russian influenza"—all this is, as perhaps some of its fashionable victims imagine, to be quite remakably well informed upon the subject. So, perhaps, we may make venture with a fact or two.

The disease known as influenza is due to, or rather consists in, the invasion of the human body by a minute plant, which was discovered several years ago by a German bacteriologist named Pfeiffer, and was named by him the *bacillus influenzæ*. It follows that one either has influenza or has it not. The bacillus is either there or it is not. Surely that is plain enough. "Bacillus" is, of course, simply the Latin word meaning a "little rod": and the *bacillus influenzæ* is a rod-shaped cell somewhere about one-eight-thousandths of an inch long. It has no visible nucleus. In other words, its visible structure is so lowly as not even to comprise the first differentiation of living matter into nuclear and non-nuclear protoplasm. It has quite recently been shown in Germany, however, that the structure of this and other bacilli is not quite so simple as was formerly thought. One fancies, sometimes, that here and there people perhaps think of bacilli as very minute flying insects. Fortunately, neither bacilli nor any other form of bacteria can fly. They can only move through the air as currents direct them. But as to moving in a fluid medium, we knew that certain bacteria have *cilia*, little movable projections by which they can propel themselves. On the other hand, we thought that most bacilli, including Pfeiffer's, had no *cilia*. It has now been shown that apparently all bacteria, of whatever shape, possess *cilia*—a fact which makes the mental contemplation of them none the pleasanter, though it is probably of little practical importance.

The influenza bacillus multiplies by simple splitting, initiated, no doubt, by the nuclear matter which we must believe to be spread throughout its substance. So far the thing is simple enough, and it would be natural to conclude that if this creature multiplies in you or me we shall, *ipso facto*, suffer from influenza. Such an assumption would ignore the first principle that life depends upon chemical processes. Similarly influenza depends upon the peculiarities of the vital chemistry of the bacillus of Pfeiffer. And since by these we suffer, we call the bacillary products poisons or, to use the Greek, toxins. These toxins are organic compounds of great complexity, probably varying in different generations of the bacillus. This difference of toxicity is expressed in the V (virulence) of the equation. Influenza is the result upon the patient, as a whole, of the interference with his normal chemistry produced by the interaction of the chemical products of his cells and the chemical products of the invading cells. In some peculiar subtlety of this struggle is to be sought the explanation of the familiar fact that influenza may take so many forms. It is, indeed, the type of a Protean disease.

What follows is simple enough to relate, though its details are beyond our ken. The toxin has its brief day, and then, fittingly enough, the very cells of the patient (whichever, in the particular case, they happen to be) that suffered most by its ravages have their revenge. They produce a new substance, which arrests the multiplication of the bacillus, deprives it, somehow, of its fuel or its oxygen, and ultimately kills it outright. This substance we very naturally call the antitoxin. One point further. Influenza—it is probably safe to say—never directly caused a death yet. In other words, uncomplicated influenza is a non-fatal disease. In yet other words (for there are many ways of phrasing such relations as these), the antitoxin is always produced in time. But the disturbance of cell-chemistry is so profound that if another invader enter at this moment, as, for example, the germ of pneumonia, this time the besieged cells, weariedly facing an unexhausted foe, fail, only too often, to supply the second antitoxin in time.

Let us recall for a moment the equation: D, the disease influenza, consists in M, the micro-organism or bacillus of Pfeiffer; V, its virulence, or the variety of influenza toxin it can produce—allied, one may note, to the ptomaines of meat—and N, its number or the dose of that poison; all these divided by R, the resistance, or power of producing antitoxin, possessed by the body cells of the individual attacked.

Yet, after all this prosaic detail, we return to the real question underlying influenza. And what is that? Well, it depends on your point of view. If there is influenza in your house or mine, the real question for us is, how shall we bring into the house so much poison as shall kill this little vegetable, lest haply it kill us. Poison I call it, for so it is to the bacillus. Antiseptic and disinfectant we call it. Nor do we nicely debate our right to slay and spare not.

So the real question, as I take it, is this: Here we all are, we cells or societies of cells, held to our common mother, the earth, by the force of gravitation, inexorable, eternal, immutable. We are all in the same boat upon the universal ocean, the germs and we. Our origin is common; from the circumpolar sea, the first to cool and render life supportable—we are told. Yet soon, with the very breath of our nostrils, enters the influenza bacillus, and if it can flourish and multiply, why should it not? It must fight or die; and why should it die? Did not the earth give it life? And yet if it survive, what of us? Are we to die, and now? And so it is war without mercy, and the battle-field our mother's bosom. Well may Mrs. Meynell say:

> "So go the town's lives on the breeze,
> Bosom nor barn is filled with these."

And the student of science boasts of his mistress as organized "knowledge"; and flaunts his clumsy, pompous polysyllables; and treats, with a would-be pretty wit, of influenza as a combat—as if every combat on the earth were not between brethren, and its issue fratricide; and "explains," forsooth, the unknown in terms of the unknowable; and leaves the real question unanswered. Why, why this accursed slaughter? Thus, science to-day leads the human mind so far and leaves it faint, sick with the smell of blood. Faint, do I say? This rather. Faint, yet pursuing.

SUGGESTION AND HYPNOTISM

THE word suggestion conveniently indicates a certain genus of emotional influences to which we are all exposed. The qualifying word "emotional" is important, since suggestion, in the sense which we wish to illustrate, must be sharply distinguished from any form of appeal to the intellect or reason. It may accompany such an appeal, and prepotently affect its result, but suggestion, in this technical sense of the word, is constituted in an appeal of an essentially non-rational kind.

To take a not particularly good recent instance, we may recall the epidemic of apparently causeless disappearances that followed a much-bruited case. If a young person already wishing to leave her home, or so placed that it might appear desirable to leave her home, were to receive an illustration of the ease with which such an evanishment might be contrived, and were forthwith to disappear, that would not be a case of suggestion in the present sense. But when one young woman, shall we say, finding all England in search of another, leaves her home without any reasonable cause, the explanation is to be found in the subtle action of suggestion.

Other illustrations are constantly furnished by epidemics of suicide, usually without apparent motive—by which we mean rational or reasonable motive. In such an instance as this it becomes clear that suggestion is closely allied to what we call the imitative faculty. Some years ago in Paris, for instance, fifteen persons hanged themselves within a fortnight from a hook in a dark corner of the Hôtel des Invalides. When the hook was removed, the suicides ceased. Similarly, also, opportunity may furnish the suggestion. In the eight years following the removal of ball cartridges from English soldiers, suicide decreased by one-half as compared with the corresponding previous period. Plainly there were other ways open to a soldier who had sufficient motive apart from the suggestion of opportunity. When it was proposed to the late Lord Salisbury that opportunities for drinking might be diminished with good results, he remarked that there were "thirty bedrooms at Hatfield, but it had not been observed that they increased the desire for slumber." The only thing certainly demonstrated by that remark was the worthlessness of analogical reasoning in unskilled hands. This essay was written in a village owned by a Scottish distiller, who knows better. He allows no public-house in the place; and the prosperous folk may be seen contentedly drinking ginger-beer in the single shop-post-office. Were suggestion not a factor in human action there would be hardly more drinking at the village two miles away, where there are public-houses—and a doctor—than here. Some day, when our rulers have had an elementary scientific training, psychological facts like the suggestion of opportunity will be taken into account in legislation.

But, apart from the phenomena of hypnotism, oratory furnishes by far the most admirable instance of the power of suggestion. I suppose the most extreme type would be shown in the effects of a religious revival upon certain temperaments. In such cases the effect of conviction on the speaker and of approval among his hearers—the preacher's *words* being the ostensible cause—may actually produce, as in, say, a negro of the Southern States of America, what the alienist calls an ecstasy. Such cases are rare, and, as the usual treatment for ecstasy is the faradic current, extremely curable. This is written in no unsympathetic spirit. The nervous excitement of which ecstasy is the outward and visible sign is a great tax upon the nervous system, and is certain to be followed by a period of reaction when the subject's depression will balance his former elevation. Therefore, it is right and needful to interfere with this state on the rare occasions on which it now presents itself.

But let us take an ordinary political demonstration. If you are at the meeting, and in the hearing mood, you may well come away convinced. Next morning read the speech, or compare your impression of it with that formed by some one who was not there, but who reads it in cold type, and you may be surprised at your opinions of the night before. You had perhaps thought, listening to the speaker, that your fine, impartial intellect was weighing the statistics and extricating the truth from the rhetoric. But you forgot that "enthusiasm is infectious" (which is just the popular way of saying that there is such a thing as suggestion), that the meeting was crowded (have you ever wondered why you prefer the theatre full rather than half empty?), and that the right honourable gentleman was all the while attacking your emotional nature under cover of a soi-disant but quite subsidiary onslaught on your intellect. It is, indeed, largely his skill in the practice of suggestion that has given him that fine title.

Far be it from me, of course, to imply that when, prior to exercising the right of franchise, a free-born modern citizen goes to hear the arguments for or against a given policy he is really being hypnotised. But one must get some explanation for things. How, for instance, did the contorted intellect of Mr. Gladstone obtain such a hold over his countrymen? Undoubtedly, because it was a mere accident in a complex total of influences which you may call personal magnetism, or may refer to the exquisite quality of his voice or to what you please, but which certainly acted through suggestion. This, of course, is the key to the power of oratory. And my readers know as well as I that the same influence is potent in the written as well as the spoken word. The writer who has felt "the incommunicable thrill of things" *can* communicate it, at a distance of oceans or centuries, if he but prove to you that he has felt it. Then suggestion—which in such instances as these latter is another proof of our common nature—calls to the kindred soul, and you too are thrilled.

But we know that the power of the "living word" is greater than that of the written, even when the writer is a genius and can convey some of his emotion to the reader. Suggestion furnishes us with two explanations of this familiar fact. The orator has, in the first place, the great advantage that he is addressing a number of people at once. Hence one aspect of what is now known as the "psychology of the crowd." The statement that enthusiasm is infectious simply means that one auditor suggests to another. But the orator or singer or violinist or conductor is further helped, as the author cannot be, by the reaction of the audience upon himself. The audience begins to "suggest" to him that it is affected, and thereby heightens his own emotion: so that we see here an automatic arrangement for insuring the effectiveness of a peroration!

What we call "personality" is also to be explained by suggestion—by an emotional rather than an intellectual influence. To take a small case, we may recall Mr. Gilbert's words put into the mouth of the poor jester in "The Yeoman of the Guard," that your acknowledged wit has only to say, "Pass the butter," and the company is dissolved in laughter. The knowledge that he is a wit has suggested to them—that is to say, has quite ridiculously heightened the emotional state which issues in laughter. And, to pass from the ridiculous to the sublime, we see the influence of suggestion in the history of the great religious reformers of humanity. Their great characteristic was "personality," "suggestion," the power of transferring emotion or, if you like, simply ***emotional genius***. At once, on realising this, we find a rational and yet by no means offensive explanation of the gifts of healing that may be possessed by such reformers. In all ages, apparently, the human nervous system——and the same applies, in lesser degree, to some animals—has been liable to affections which we do not understand and which a past age called by the peculiarly bad name "hysterical." Nowadays we call them functional or neurotic. Only those, however, who do not "know what they do not know," imagine that they understand them. All these disorders—which are apparently becoming more frequent in our time—are amenable to suggestion, especially if the hypnotic state be first induced by it. Hypnosis is invariably produced by suggestion—either suggestion by another or self-suggestion. The ability to sleep at any time, said to be possessed, for instance, by Napoleon, is probably due to the use of self-suggestion. Nowadays several people, who have first been taught by a hypnotist, use this means of obtaining sleep. Somnambulism is hypnosis in its extreme form, and is perhaps induced by suggestion in a dream.

We must completely abandon the old idea of Mesmer and others that suggestion is due to animal magnetism. It is a purely psychic phenomenon; and terms like "personal magnetism," "mesmerism," etc., should never be used, since they can hardly do aught else than darken counsel.

We are sometimes apt to be too hasty in our verdict on the temperaments to which suggestion can appeal. My instances of the young woman—note her age and sex—the suicides in a French hotel, and the negro revival—note the emotional nature of the two races—and the tippler, will clearly point the moral that hysteria—loss of self-control—which is now quite one of the most interesting and significant things in the world, and ordinary loss of self-control, as in the alcoholic subject, have a great deal to do with the power of suggestion. These are plainly cases of suggestion acting on morbid temperaments. In another class we may put the instance of the Indian juggler who throws a rope up into the air, sends a boy up it, and then causes both to disappear. The camera—sans emotion—detects neither rope nor boy. We are told that if the trick is done before a mixed but divided audience, the Orientals, sitting on one side of the tent, will swear to the objective existence of the rope and the boy, while Europeans, sitting on the other side, have seen nothing. The conjurer has hypnotised his fellow-countrymen only. Here, then, we have a case of suggestion acting on ready temperaments, which we cannot call morbid, but which are still very different from ours. And here, also, is a modern reading of the fact that miracles happen only in the presence of those who are prepared to believe in them.

Having disposed of one class of cases as instanced in a morbid or inferior, and another as instanced in the Oriental temperament, what are we to say of the Anglo-Saxon who is "completely carried away" by stump oratory, or, indeed, of the man who responds to the "suggestion" exercised by a Phidias or a Dante or a Beethoven? Anatomy having taught us the names and causes of the "surface markings" of a sculptor's Venus, astronomy having returned a *non possumus* when asked to locate the whereabouts of the "Inferno," mathematics, physics, and physiology having agreed to analyse the effect of the "Eroica Symphony" on our ears in terms of logarithms, are we, therefore, to flee from these things, muttering "suggestion" as an exorcism? Or, in other words, fearing hysteria and "neuroticism" and insanity, are we to consider all things in the "dry light" of reason, and that alone? That would be to vindicate the gratified ignorance which declares that science is a foe to all that makes life worth living. If we so strangle our emotions that the beloved's finger-tip will feel like any one else's—because, forsooth, the "objective stimulus" is similar—then assuredly were we better dead. If, on the other hand, despising or denying the existence of absolute truth, you cultivate the emotions alone, and expose yourself to every wind of suggestion that blows, then, being without reason, are you in danger of losing your right to be reckoned human. This, then, for the partisan—whether of one or other political party or religious creed, or of the intellect as opposed to the emotions, or the emotions as opposed to the intellect—*in medio tutissimus ibis.*

THE EVIDENCE FOR TELEPATHY

THE question of telepathy or thought-transference is one which necessarily interests everybody. It is approached from many stand-points. Some seek to prove the existence of this phenomenon because, unless they can, they feel bound to accept the assertions of the spiritualists—which greatly irk them. Others approach the question with the desire for an adverse verdict, because they think that a general belief in the possibility of thought-transference might tend to lend support to the delusions from which many of the admittedly insane, and a good many other members of the community, occasionally suffer. Others, again, are interested because of the immense importance of this question to scientific psychology, and because it might throw some light on the still-unsolved problem of the relations between mind and matter. Physicists are interested because, like every one else, they cannot conceive of "action at a distance," and, if telepathy be a fact, they want to know about the medium by which the thought is conveyed. Physiologists are interested because they know of no sensation that has not its terminal sensory organ—

eye or ear or skin—and if telepathy be a fact, they must believe that the brain can receive impressions directly, without the intervention of any such sense-organ. They know that even if the surface of the living brain be touched, the touch is not felt, and they incline to declare that a sense-organ is essential. Therefore the talk about telepathy irks *them*. And the general public is interested, because it can recount many instances within its own knowledge where telepathy seemed to be the only reasonable explanation.

By the courtesy of Sir Oliver Lodge, the distinguished Principal of the University of Birmingham, the present writer has been allowed to see the material bearing on the subject of thought-transference or telepathy that has been collected by the Society for Psychical Research in this country during the past twenty years. One was led to the subject by Sir Oliver Lodge's third presidential address recently delivered to that society, in which he spoke of telepathy as being scientifically proved and accepted. If this were so, which it assuredly is not, the fact would be of immeasurable importance. Indeed, I am astonished that Sir Oliver does not now devote himself to this subject to the exclusion of all others. His admirable theory of electrons, to which we are all so greatly indebted, might well be left to other physicists. Sir William Crookes' investigations into the occult have led him to a "brick wall"; but Sir Oliver's beliefs on this most fascinating of subjects would lead him and us (if they be well founded) to conclusions of quite incalculable value. Now that he has perfected his system of wireless telegraphy and has therein obtained an analogy for thought-transference far superior to any imagined or suggested before (and the telepathist loves the argument from analogy—that most dangerous of all logical instruments), he might crown all by the discovery and adaptation of the laws—for laws there surely must be—that govern the transmission of thought directly from mind to mind.

The difficulty of conceiving an hypothesis for telepathy and the fact—if one may be forgiven for alluding to it—that the Society for Psychical Research is, to say the least of it, not a body of physiologists, is no doubt the reason why the society confines its efforts almost entirely to the unimpeachable and perfectly scientific method of proving that telepathy exists—that it is, in Sir Oliver Lodge's words, an "experimental fact." And if the fact be proven, then the *a priori* objectors, the present writer included, must away to the limbo of most of their predecessors. Necessarily, therefore, it would be the sheerest folly to attempt to prove that telepathy cannot be, unless one has first sifted the evidence in as judicial a manner as possible. If it be found wanting, then one may venture to suggest the reason.

Needless to say, if, to take a favourite instance, a person at one end of a room guesses correctly a proportion of the suits and numbers of playing-cards which he has not himself seen, and which are turned up at random and earnestly gazed upon by some one at the other end of the room, the question at issue depends upon the relation of these correct guesses to the number which must follow the laws of chance. (I use the term "guess," which is an invidious one, not because it favours my view, but because it is convenient, and, as such, is used by the society itself.) And here "let us clear our minds of cant." The Society for Psychical Research has suffered beyond telling from accusations of one or another form of dishonesty. From these we entirely dissociate ourselves. The society wishes to get at truth, and is, of course, striving to do so as honestly as any other body or person. In the very nature of things, it labours under exceptional disadvantages in this regard. "Spiritualist cases" and the like must be a bitter pill for the believer, but they have no necessary connection with his beliefs nor should they have with ours. Every word of the society's *Proceedings* must be freed from any suspicion of conscious fraud, and must be accepted and criticised as one would accept or criticise any other serious thesis—without for one moment questioning the propounder's good faith.

Now, since the protagonist of telepathy must prove that his results are beyond probability, Sir Oliver's paper, to take an instance in Part II. of Vol. II. of the society's *Proceedings*, is simply valueless. Let me quote: "In proceeding to the details of the actual experiments, it would take far too long to recount the whole—failures as well as successes; I shall only describe a few from which a more or less obvious moral may be drawn." From a selected few, of course, no moral may be drawn—or certainly not the moral intended. When I asked a representative and official supporter of telepathy how he accounted for failures, he said (I copy the words from my note-book, for they were too good to trust to memory), "Well, it's *exactly the same*—mind, I don't say that there's *the slightest analogy*, but it's exactly the same as if you had twenty Marconi instruments all going at once across a given area." No comment on the contradiction in terms is needed. To assert that telepathy is "scientifically proved"—not to say "accepted"—when failures are accounted for by an illustration which is "exactly the same," though there is not "the slightest analogy," is simply to waste time and trouble. Telepathy will be scientifically proved when, over a sufficiently long series of experiments—so long that chance may fairly be excluded as conducing to their success—the ratio of success to failure is higher than the law of probability will account for. Sir Oliver omits the failures, records the successes, and asks us to draw an obvious moral. The obvious moral is that, as long as the very fallacy which must be excluded is deliberately countenanced, the recorded experiments prove precisely nothing at all. If we had the records of every experiment conducted by the society during the past twenty years; if all these experiments had been properly safeguarded—as a great many were certainly not—then we would have excellent data from which to draw a conclusion. But the society naïvely assures us that it would "take too long" to recount the failures. Thus is telepathy "scientifically proved"! The entire argument resting upon a comparison of numbers, we will first select the numbers which suit us—"it would take too long to recount the whole."

Now, the unthinkable theory of an "actio in distans" having gone the way of much—though not all—ancient nonsense, we must try, if we believe in thought-transference, to conceive of a medium and of some sort of action in that medium. Sir Oliver Lodge says that I must not attribute any such hypothesis to him. Mr. Podmore, I believe, has made the very obvious suggestion of some form of ether-wave. If we care to ignore all that is known of the physiology of the gray surface of the brain, and choose to assert that it acts by means of waves, ethereal or other, some such hypothesis may appear tenable. As a matter of fact, to take the simplest case, we have not the remotest idea what happens even when a simple motor impulse is sent along a single nerve. All kinds of experimentation have been employed. No chemical change appears to take place in the nerve. No change occurs that can be seen under the microscope. You may stimulate the nerve violently for hours without affecting it. The nerve-cells at one end of it, and the muscle-cells at the other will soon show obvious signs of fatigue, but the nerve-trunk cannot be fatigued. Except that the impulse is not instantaneous, but takes a measurable period of time in passing along the nerve—more than sixty yards a second is said to be the rate—we know nothing whatever. All known ethereal waves travel at the rate of about one hundred and eighty-six thousand miles in a second; so that a nerve-impulse can hardly be an ethereal wave, though in passing it generates an ethereal or electric wave in the nerve. Serious responsible science disclaims any knowledge at the present time of the nature of a nervous impulse—and, a thousand times more strenuously, of the nature of thought.

As regards the central part of the nervous system, it is known that electrical waves pass between less and more excited portions of the brain as they do in muscle or, indeed, as Dr. Bose has shown, in carrots or in tin. The relation of these waves to thought is therefore entirely accidental. Changes in the nerve-cells, especially in their nuclei, are, however, to be found associated with thought, with fatigue, and with sleep, and well worth pondering over they are. Recently it has been shown that Hertzian waves may affect the brain of a cat—it would be very surprising if they did not—and the effects of thunderous weather in causing headache and the like may be so explained. This, as briefly as possible, is all that is at present known about brain waves. And at this point I may quote—it speaks for itself—an opinion about crystal-gazing expressed in a lecture which Sir Oliver has sent me, and by which he may, therefore, be assumed to stand. "It is possible that the clairvoyant is responding to some unknown world-mind of which he forms a part." Similarly, when it was suggested to my informant quoted above that the brain was the organ of mind, and that before one was qualified to experiment or to express opinions upon the action of that organ he must study its structure and action in health, must observe it in gross disease and in hysteria, and must then study it for at least three months in a lunatic asylum, he asked, "Can you say that the brain is the only organ of mind?" Well, of course we cannot. Neither can we say that there may not be some obscure corner of the universe wherein the law of gravitation does not act. But if facts are laid before us which suggest some defiance of established law we must attempt to find some simpler explanation before we are prepared to recant our belief in that law. So, in dealing with the occult, we must follow Sir William Hamilton's Law of Parsimony, and seek for the simplest explanation, which is the explanation that does not contradict ascertained knowledge, before saying that the brain is not the only organ of mind or that gravitation does not act everywhere. Probably no one would be so foolish as to assert, especially in the light of recent discoveries, that the brain is the only organ of mind; but there is certainly no evidence of the existence of mind *as we know it*, except in relation with the brain; and the parlous state of thought-transference or any other subject is shown when its advocates attempt to bolster it up by speculations which have nothing in their support and all the evidence against them. Speculation is essential in science, and it permits us to say that this or that *may be*, but assuredly not that it *is*.

The most successful experiments recorded were made by Professor Sedgwick in 1889. To these, as crucial, the attention of the critic is specially directed. The "percipients" were hypnotised and guessed numbers at which the "agent," Mr. Smith (the hypnotiser), was gazing. When the two were in the same room the results were 131 successes out of 644; when in different rooms 9 successes out of 228. The figures chosen ranged between 10 and 90, and a success was counted whether the figures were given in the right order or reversed. The results are far above probability when the two were in the same room. Having carefully studied the account of the experiment, with the conditions as far as they are stated, and with the accompanying conversation, one is bound to say that, even taken by themselves as if they represented the average result, they prove absolutely nothing. There is no need to go into possible explanations, such as unconscious whispering, etc., for could these results —even assuming them to be worth anything—not be easily balanced by a few of those failures which "it would take too long to recount"? If telepathy be a fact, fifty thousand experiments will record it as well as, or better than, fifty. The larger the number of cases the better the rebutment of chance. But we may guess that chance has a way of reasserting itself when the numbers are multiplied.

The conclusion, then, is that the Society for Psychical Research has not established telepathy as an experimental fact; that, even if it be a fact, the society cannot hope to prove it until its members have completed courses in a psycho-physiological laboratory (and that means some years in simpler laboratory work first); and that, meanwhile, it is more than doubtful whether they are not fostering credulity and superstition with all the innumerable and often terrible evils to which the boards of the Regent Street sandwich-men, the advertisements in fashionable papers, the law-courts, and the experience of every one of us bear implicit or explicit witness.

THE WAYS OF MEMORY

THE mystery and wonder of memory are hardly realised by us until we begin to make systematic use of the power. I well remember standing before the skeleton of a bat in a certain museum and trying to check a fellow-student's account of the homologies and analogies between the bony structure of a flying mammal and a bird, when he suddenly interrupted himself and said, "What an astounding thing it is that one can remember all these things!" He little knew that he had yet to memorise the names of all the bony and other structures at the base of the human skull. But from that moment I have realised, in some little degree, what a marvellous thing is memory.

Believing, with Pasteur, that in a sense "Tout est miracle," one is ever tempted to exclaim at the wonder of the particular subject under discussion. But, of course, we must admit that memory is very far from being the most wonderful of mental functions. It is a bagatelle compared with any form, however attenuated, of creative genius. It is much less inexplicable than even the simplest process of ordinary thinking. But it is remarkable enough when seen in a man like Inaudi, the lightning calculator, or a child like Franz von Vecsey, the violinist, whose large repertoire is the fruit of less than two hours' daily practice, or in the chess-player who can simultaneously conduct a dozen games blindfold. Musicians tell us that the memory of Dr. Richter is their chief cause of admiration in his case; no other living conductor can approach it. Yet memory is far more wonderful when considered from a profounder stand-point in its relation to the problem of personality. For are you not *yourself* simply in virtue of your memory of past experiences?

Recent writers, again, have shown us that we may recognise memory in the still more subtle guise of heredity, which may be regarded as cell-memory. Nor is it unthinkable that, if the reproductive cells may remember and reproduce the tricks of gesture or tones of voice of a parent, they might even be regarded as reproducing ideas acquired by the parent. This, however, would be to hold, in its extreme form, the view that acquired characters are transmissible: while it is, of course, the obvious and unfortunate fact that the new generation does not start with the knowledge of the old, but has to make a fresh start at the beginning for itself.

But, confining ourselves to memory as the term is generally used, let us inquire whether any sort of explanation, however imperfect, can be offered for it.

Modern psychology holds—it has no choice—

that every memory means a change impressed more or less deeply upon the gray surface of the brain, or *cortex cerebri*, the apex and flower of the material universe, beside the wonders of which radium and its attributes are of a quite immeasurable triviality. When a singer, after long practice, learns to get well "forward" a note which was formerly "throaty," those cells in the motor area of his brain that control the muscles of his throat and tongue and palate have acquired by practice a *memory* which thereafter enables them so to co-ordinate the movements of those muscles as to insure good "production." The effect of practice, as in any other art, mechanical, mental, or both, has been so to alter the constitution of the nerve-cells as to produce a new mode of action. Beyond a doubt, this is the physical basis of memory. And it is worth noting that no practice or thought ever adds a single unit to the total number of cerebral nerve-cells—about two thousand millions —with which one is born. Nerve-cells are significantly incapable of division and reproduction. They are the highest expression of *individuation*, and have consequently lost altogether the function of *reproduction*, in accordance with the principle discovered by Spencer and shown to hold throughout the whole range of life, that there is an antagonism between these two functions. All the experience of living merely modifies the state of the cells already present. That modification is memory. But though a nerve-cell cannot divide, it can send forth new processes on nerve-fibres from itself—what we call a nerve being simply a collection of processes from a nerve-cell. Throughout the brain and spinal-cord we find great numbers of nerve-processes which simply run from one set of nerve-cells to another, instead of running to a sense-organ or a muscle or a gland. Such fibres are called *association fibres*, their business being to associate different sets of nerve-cells. It is conceivable that an exceptional development of such fibres may account for the possession of a good memory, or, at any rate, for the possession of the power easily to learn such co-ordinations as are implied in violin-playing, billiards, cricket, or baseball. Granting the power of nerve-cells, even when adult, to form new processes, it might be supposed that the exercise of this power accounts for the acquirement of certain habits of thought or action. But this is mere speculation.

This principle of *association* is at the basis of all memory systems. What the school-boy calls a "mnemonic" is simply a means of aiding memory by association. And the faculty of association, or of using one's association fibres, is greatly aided by the law of least resistance in nervous action. Nervous impulses, like physical, tend to follow this principle. The influence of conscious effort in memorising anything may be ascribed to the making of certain desired nervous paths become the paths of least resistance. When, by the exercise of the faculty of *attention*, these paths have become well defined, memory becomes automatic and unconscious, as in the practised opera-singer, who is thus free to devote himself to the higher interpretation of his part, his nervous action having been so completely trained in the way it should go that his attention is no longer required to guide the process.

Now let us go a step further. The cerebrum consists of two halves, or cerebral hemispheres, the only direct connection between which is provided by a number of "commissural" nerve-fibres which cross over transversely[1] from one side to the other, forming a white body known as the "corpus callosum." (When association fibres join the two halves of the body they are called *commissural.*) The fibres in this bridge come from and represent every area in the hemisphere of either side. Now there still remains a popular notion that it is the front part of the brain that does the thinking. We will not discuss that view here, but merely state the modern belief that, for the processes of consciousness, no less than the entire cortex is needed—and no wonder. Nevertheless, each cerebral hemisphere may be regarded as probably a complete unit capable of producing consciousness, though the services of both in co-ordination are doubtless preferable. We cannot but believe that each hemisphere is *potentially*, at any rate, independent, for they are symmetrical in structure, neither containing anything that the other has not. Now the co-

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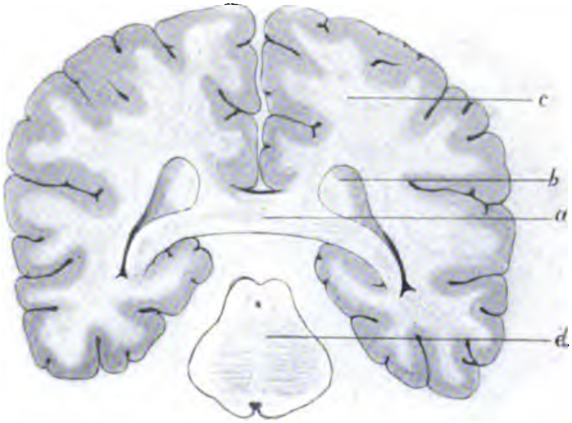
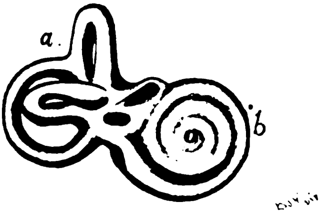
[1] See illustration facing this page.



TRANSVERSE VERTICAL SECTION OF THE HUMAN BRAIN

a. Corpus callosum joining the cerebral hemispheres.
b. Lateral ventricles.
c. The fibres of the corpus callosum radiating through the white to the grey substances of the convolutions.
d. Section through the corpora quadrigemina, aqueduct of Sylvius, and pons Varolii.



SEMICIRCULAR CANALS AND COCHLEA

a. Semicircular canals. *b*. Cochlea.

ordination certainly takes place, as regards intellectual processes, by means of the "corpus callosum." This very reasonable assumption from their structure—that the two hemispheres may be functionally independent—seems to offer an explanation for a phenomenon which almost every one has observed. You enter a room which you have never seen before, and are haunted by the conviction that it is all familiar, or you read a new book and cannot divest yourself of the impression that you have read all these phrases before, each in its identical position on the page before you. Have you visited this spot or read this book in some stage of your individual pre-existence? Or have your parents been in this same room before your birth, transmitting their memory of it to you? Such theories might be held as regards the room, but are obviously inapplicable to the book, which is just fresh from the press. But for this familiar illusion, which I believe to be nothing more than a trick of memory, I fancy we can frame a reasonable explanation based upon our knowledge of the anatomy of the brain.

Is it not possible that, now and again in certain persons, circumstances may interfere with the simultaneity—or approximate simultaneity—of action of the two hemispheres? The visual image of printed words, which passes—such is the arrangement of the fibres—from *both* eyes to *both* hemispheres, may be perceived by the one somewhat before the other.

In such cases as the familiar one of reading a new book and fancying that one has read it all before, it may be supposed that one-half of the brain perceives the words a second before the other, and sends across an account of them to the second hemisphere by means of the "corpus callosum." Immediately thereafter, the words reach the second hemisphere straight from the book. But that hemisphere has already had private intelligence on the subject from its more rapid fellow; so when the new account comes in from the eyes it very naturally says, "By Jove, I've seen that somewhere before!" Its error is excusable, for it is only the rare exception for an appreciable interval of time to separate the action of the two sides. I am tempted to go further—to become more materialistic than ever, I may be told—and suggest that if one side of the body be next a fire, let us say, and therefore somewhat warmer, the scalp of that side will be warmer—and will contain more blood. The circulation of the scalp and that of the *cortex cerebri* are connected, so that for the moment, and in persons whose vaso-motor apparatus is sufficiently sensitive, one cerebral hemisphere may be somewhat better supplied with blood than its fellow. Hence there will be momentary departure from synchronous action.

But even supposing that this, or something like it, is an explanation of one of the ways of memory, what can be made of the following instances—which might easily be reduplicated—from the case-book of a physician who practises hypnotism? "One of my subjects, if told to do something at the expiration of a complicated number of minutes from a given hour, as, for example, 20,845, almost invariably carried out the suggestion with absolute precision, while no recollection of the command or its execution existed in the primary consciousness."

Such are some of the ways of memory!

SPACE

We all conceive of space as having three dimensions. The mathematician, it is true, can postulate a fourth dimension, and perform many very remarkable feats with it; but neither he nor any one else can really frame a conception of this fourth dimension. He agrees with ordinary people that a fourth dimension is unthinkable.

Now it is certainly not worth while to attempt any *proof* of the tri-dimensional character of space. But we may attempt to adduce what is, so far as I am aware, an argument more or less new in favour of the view taken by realism that our conception of the tri-dimensional character of space does truly correspond with objective reality. Hearing of the mathematician's achievements with the fourth dimension, people have recently asked whether science has proved space to have four dimensions. I want to show, if possible, that we can adduce something like scientific presumption for the assertion that space veritably has three dimensions.

It is dangerous work to attribute any belief to the idealists, for, with the exception of Berkeley, they are all interpreted differently by each of their followers. But we may take it that a typical idealist would deny the existence of anything in the outer world which veritably corresponds to our conception of space as having length, breadth, and depth. To such an idealist, who declares space to be *no more* than one of the forms in which, owing to the possession of an innate idea concerning it, we think—I want to point out certain anatomical and physiological facts which seem to me to disprove his assertion.

At the base of the skull of each of us there is, on either side, a bone which is known as the *petrous* bone, owing to the fact that it is the hardest or "rockiest" in the body. It contains the inner ear or essential organ of hearing, and its hardness is doubtless an adaptation to this function, since the harder it is the better it will conduct those vibrations which our sense of hearing indescribably converts into sound. The inner ear is supplied, on each side, by the eighth cranial nerve, which is therefore known as the auditory nerve. But it has been discovered that the auditory nerve really consists of two divisions which have totally different functions and totally different courses inside and outside the brain. One of these divisions has nothing to do with hearing, but with the preservation of our equilibrium or balance. It is the nerve of equilibration and runs to the peripheral organ of that sense. Unlike other peripheral organs, however, such as the eye or ear or nose, this organ is not literally peripheral at all, and we shall see that there is no need for it to be so. It lies beside the inner ear in the heart of the petrous bone on each side. Its function is to tell us the position of our head *in space;* and when it is disordered we suffer from incurable vertigo, reeling like a drunken man, simply because we do not know where we are.

Before proceeding to describe it, one may observe that this organ is much aided by several of the other senses. The nerves of the soles of the feet, for instance, are of great value in helping us to equilibrate ourselves. If the soles are painted with a strong solution of cocaine, the art of standing erect is made much more difficult. Then, again, our eyes are certainly of use in helping us to preserve our equilibrium. In a certain common nervous disorder, the nerves from the soles of the feet are affected, and the patient cannot stand upright with his heels together and his eyes shut. This symptom has been utilised by Sir Arthur Conan Doyle in one of his stories. But the symptoms of disorder of the essential organ in the petrous bone are much more severe than these.

Now, of what does the organ of equilibration consist? It is composed of *three* tiny canals, each of them shaped like half a circle. Each of the three semicircular canals[1] contains a fluid, in which lie the numberless terminations of the nerve of equilibration. Every movement of the head, however slight, will cause a tendency to movement in the fluid and therefore a pressure upon the nerve-endings. The brain is informed of this pressure, and so we know how our head has been moved. This theory, which is now generally accepted, was originated by Professor Crum Brown, of Edinburgh, who is better known as a physiologist than as a chemist. Now space being, as we believe, tri-dimensional, it is possible for the head to be moved in three directions or in compounds of them. We may nod our head, shake our head, or depress or raise it vertically. How, then, are the three semicircular canals arranged on each side of the head? *They are arranged in correspondence with the three dimensions of a cube*, two being vertical, but at right angles to each other, and one being horizontal. The arrangement on the two sides is symmetrical, so that every possible movement of the head exercises a corresponding influence on some pair or pairs of the six canals: nothing can escape them.

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[1] See illustration facing page 132.

Hence it happens that after considerable rotation in one direction, as in waltzing, one acquires a giddiness that can be relieved by "reversing," which neutralises the pressure of the fluids in the horizontal pair of semicircular canals. Professor Crum Brown has made many experiments in this direction, as by putting an individual upon a rotating table and then reversing the direction of rotation.

Now if we go down to the lowest vertebrate animal we do not find these canals at all. The fish simply has an organ named the utricle, which is its ear, and perhaps serves partly to equilibrate the fish as well. As we ascend the vertebrate scale, we find the gradual evolution of these three canals, and pathology tells us that the vertigo which ensues from disorder of them corresponds to the direction of the particular canal or canals which may be affected. For instance, if the horizontal canals be affected, it is the movement of "shaking the head," or movement in the horizontal plane, which upsets the equilibrium of the patient. These observations have been absolutely verified by the experiments of Flourens on the pigeon.

One cannot offer any explanation of the association between the semicircular canals and the organ of hearing. It was at one time suggested that their function may be to enable us to judge of the direction of sounds; but that view has been shown to be quite erroneous. And, after all, there may be no significance in the connection. Ear, semicircular canals, larynx, and other structures are all evolved from the structures that support the gills in the lowest vertebrates, and the association of the organ of hearing with that of equilibration may be a mere matter of evolutionary convenience.

Now as to the relation of these facts to the nature of space. If I simply argue, in controversy with the idealist, that the number and arrangement of the canals prove this tri-dimensional character of space, I can imagine a just reply. "Not at all," he would say; "all you have shown is that you believe space to be tri-dimensional because you have a tri-dimensional arrangement for appreciating it. You are arguing in a circle." But it seems to me that there is an answer to that argument. What I want to know is this: If space is not tri-dimensional in verity, *why* should there have been evolved within our heads a tri-dimensional arrangement for appreciating our position in it?

IS MAN ALONE?

THE scientific "sensation" of the year 1903 was the publication by Dr. Alfred Russel Wallace in the *Fortnightly Review* of two articles, subsequently followed by a very large book, in which he attempted to prove that the object and design of the entire universe was the production of the living soul within the body of man. One says *scientific* sensation, because Dr. Wallace is a distinguished scientist; not because the astronomers learned any new truth from him or because he proved or went anywhere near proving his case. But the book has had a large sale, has gained the high approval of the Bishop of Ripon and many other amateur judges, and raises again the old question—is there life on other worlds than ours, or is man alone in the Cosmos?

But first let us glance at the history of Dr. Wallace, whose *Wonderful Century* has made his name familiar to so many. He owes his fame to the fact that, in the year 1859, when he was in the Malay Archipelago, suffering from malaria, there occurred to him, as he lay perspiring under the "hot stage" of a paroxysm, the idea that natural

DR. ALFRED RUSSEL WALLACE

selection—to use Darwin's phrase—might play a large part in the origin and perpetuation of species. The notion was suggested to him, as to Darwin, by reading Malthus's *Essay on Population*. Darwin had been working out the idea for some years, but had not published his results, and a now historic paper, prepared by both naturalists, was read in London some short time before the *Origin of Species* appeared. The idea was not new: it had been promulgated before by various people, such as Matthew, Wells, and Spencer; but all honour is due to Dr. Wallace for his conception of it and for the work he did thereafter. The world also knows Dr. Wallace as the describer of many species of animals studied by him on his travels, as an anti-vaccinator of the blindest, a spiritualist of the most credulous, a burning and noble opponent of militarism and social injustice—and, finally, a would-be restorer, in a new form, of the exploded astronomy of the pre-Copernican age. Altogether a most remarkable man.

It is obvious that for Dr. Wallace or any one else to justify the contention "that our earth is the only inhabited planet in the whole stellar universe" it would be necessary to adduce evidence which would prove that our earth is the only *inhabitable* planet in the universe; and it is apparent that Dr. Wallace, therefore, practically set himself the stupendous task of attempting to prove a "universal negative." It needs not ten seconds' consideration to show that the task is logically impossible; but on what slender evidence Dr. Wallace and his lay supporters think that he achieved it would astound any one who fancies that emotional prepossessions are not often sufficient utterly to destroy the logical faculty in the minds of those whom they obsess.

It is not possible, until we think about it, fully to realise how untenable is the position of those who fancy, with Dr. Wallace, that the Cosmos was made for man. No allusion can be found in Dr. Wallace's book to the disproportion between the material universe and its supposed object, man—the latest of the ephemera—save in a single passage where the author seeks to explain the disproportion *in space* by the analogy of the complex machinery necessary to produce a pin. As to the disproportion *in time* the author makes no reference. For what is it that he asks us to believe, and has written this most paralogistic of books in the attempt to prove? It is that at some distant period —and Dr. Wallace makes much of its distance, as an argument in his favour—this universe was called into existence, by the will of a Creator, for a specific purpose—the production of man. Assuming, for the sake of the argument, the initial fact, we must agree with Dr. Wallace in assigning hundreds of millions of years to the age of the universe. Then there arrived man. He has been here for a few hundreds of thousands of years. He has still a few — a very few — millions of years to run — assuming that his intellect does not enable him to avert his fate. It is true that in one place Dr.

Wallace speaks of him as "permanent," but elsewhere he repeatedly admits that there must come—and that comparatively soon—a period to man's existence. But he has apparently never asked himself, "What then?" We know that matter and energy are indestructible. We have every reason to believe that the universe will exist forever, and Dr. Wallace suggests no alternative. Yet he believes that the hundreds of millions of stars were called into existence æons ago and will continue to exist for a quite indefinite period to come, in order that man might live upon the earth for a few millions of years—a fraction of a second in an eternity. Let him, or those who believe with him, give us an analogy for this disproportion.

Take an instance of the pass to which our author is come in defence of his astounding thesis. Having proved, to his own satisfaction, that never before in the history of things, and never in time to come, nowhere in the solar system nor otherwhere, has been, is, or will be anything comparable to man, he has, of course, to explain the existence of the stars. Now, had I been attempting to prove his thesis, I should assuredly have suggested that the stars were created to produce in man a sense of the power of the Eternal, to aid in the development of his intellect, and to cultivate in him the spirit of reverence and humility. Such an argument — of course it is not new — might, I think, have been at least defensible; and it would obviously be very hard to rebut. But our author is reduced to estimating the exceedingly trivial amount of starlight that reaches us and to suggesting that there may be rays—as of course there may—that favourably influence living matter; all to lead up to his conclusion that—

> "in order to produce a world that should be precisely adapted in every detail for the orderly development of organic life culminating in man, such a vast and complex universe as that which we know exists around us may have been absolutely required."

We may let pass the curious inversion of biological truth which would have the world adapted to life rather than life to its environment. In other words, the power that produced the universe found it "absolutely required" to create some fifty thousand stars in the Pleiades, millions of stars and nebulæ and other bodies elsewhere, and to wait for millions of years, in order to produce man. What a ludicrous conception of omnipotence! The mind that had conceived man, and that, according to Dr. Wallace, *created* the universe out of nothing, was absolutely compelled to do it thus! How does this notion of shackled omnipotence compare with the ancient Jewish conception which declares that God desired something "*and it was so*"?

In order to prove his case, it would, first of all, be necessary for any one who wanted to show that man is alone in the Cosmos to demonstrate the finiteness of the starry universe. With the aid derived — with doubtful legitimacy — from a recent work of the famous American astronomer—Professor Simon Newcomb—Dr. Wallace essayed this task. But in a subsequent book Professor Newcomb has described an imaginary flight through an *indefinite number* of finite starry universes, of which ours is one. Dr. Wallace must prove that these other universes do not exist. In attempting to show, again, that our universe—even assuming it to be the only one—really is finite, those who think with Dr. Wallace have urged the argument that the sky should be continuously covered with stars, if there is really no end to their number. But they have forgotten that there are numberless *dark* stars. "As well," said Sir Robert Ball, the other day, "might you count all the *red-hot* horseshoes in England, and say 'these are all there are'!" Similarly the recent discovery of dark nebulæ, explaining certain of the apparent rifts in the milky-way, must be ignored. That the habitableness of the satellites of any stars at the supposed "confines" of the universe might be discounted, Dr. Wallace had to suggest that possibly gravitation might act but irregularly there, so that no evolution of life would be possible. This supposition he later retracted, offering no other in its place. The motion of the entire solar system—some twelve miles a second—having been pointed out to him, he disposes of it by saying there is no proof that this motion is in a straight line, and that the solar system may be revolving around the supposed centre. So it may, but that is for him to prove. I may be standing on my head at this moment, but it surely remains for Dr. Wallace to prove me so before he proceeds to draw any deductions from the assertion. As far as astronomers can tell, this "proper motion" of the sun would carry him and us, in a few thousands of years, from boundary to boundary of the universe conceived by Dr. Wallace. And he has to reject the nebular hypothesis—first conceived by Kant, inspired by a hint from Lucretius, and elaborated by Laplace—though it is now generally admitted that every proof which could be asked for in support of any belief we now possess in regard to this magnificent conception. Such are a few—only a very few—of the difficulties which embarrass any one who thinks with Dr. Wallace.

Far otherwise is the probable truth of this stupendous question. The spectroscope has taught us that what we still call the "elements" go to compose the sun, the comets, the nebulæ, the farthest star, as they do you and me. Everything goes to prove that law is universal. The gravitation that swings a sun determines the occasional coldness of your feet or the shape chosen by the designer of the Great Pyramid. Neither time nor space affects the eternal and omnipresent reign of law. The great probability is that *every* planet of *every* sun becomes in its turn the seat of organic life, which develops from the dust of a satellite of Sirius by the operation of the law which determined its production here. As it is now, so it was in the beginning—if beginning there was—and so it ever shall be, world without end. The inhabited period may well be but a brief span in the youth of a planet. It is a matter of temperature. The chances may be, as has been suggested, that at any given time it is four hundred to one that any given planet—of our system or any other—is not inhabited. We used to hear of creatures different from ourselves, life without oxygen, and so forth. Ere we knew that one and the same stuff, modifiable under universal laws, is the raw material of everything, such speculation was legitimate. But now we must the rather conceive of man as inevitably produced by the evolutionary changes which have occurred in the solar nebula: we recognise that nebula to have been, in all probability, similar to countless such; and we must contemplate the production of beings, such as ourselves, in the planets formed, in all parts of the infinite universe, therefrom. So far is this earth from being unique that it is rather infinitely common, as part of a universe which is infinite, not only in extent, but in unity and conformity and in its obedience to laws which admit of no exception, and of which neither time nor space can disturb the uniform and irrefragable sway.

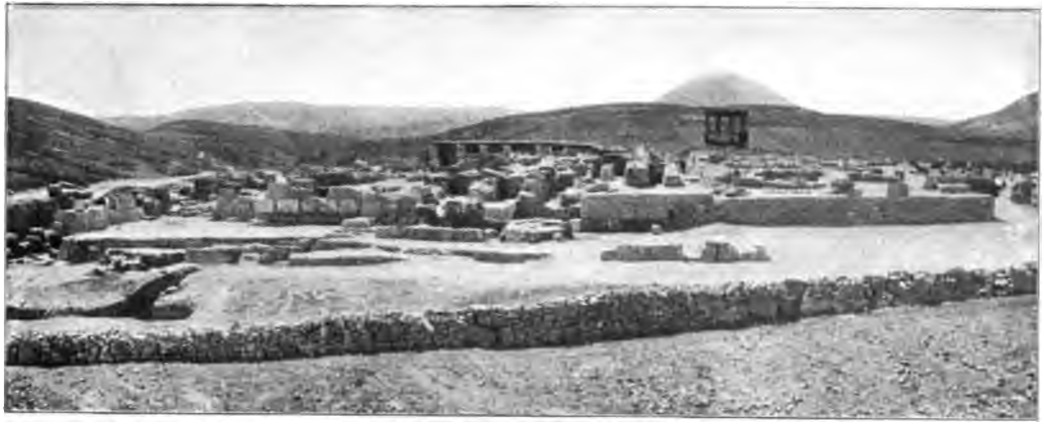
As for us, humbled beyond measure by our own discoveries, need we therefore be ashamed? Assuredly not, and for a thousand reasons. For, to begin with, we are part of the cosmic process—an organic part in the stupendous whole. Were all the forces of the universe ranged to destroy a single electron that now helps to compose you, or to annihilate one iota of the energy with which you are infused, they would utterly fail. For you, too, are part of the eternal. It is possible to think otherwise than Dr. Wallace, without the least loss of the sense of self-respect or race-respect. To us, human life, its origin and its destiny, is the most important thing in the universe, whether or not there are other worlds like ours. If you are as valid and significant an object to yourself, believing in the known and familiar truths of modern astronomy, as you would have been had you lived at any time between Ptolemy, Eusebius, and the clumsy destroyers of Greek science, on the one hand, and the publication of Copernicus's masterpiece on the other, then you will agree with me that there is really no need for proof of Dr. Wallace's thesis. Nor in contemplating the ceaseless rhythm of the universe, and its infinite possibilities, must we forget the wonder that to us, dust of a weary satellite of a dying sun, a scroll so sempiternal has been unfolded. In proportion to the grandeur of our knowledge is our dignity. If Copernicus and Darwin were right, how can the discovery of *truth* lessen the dignity or self-respect of the discoverers? Ruskin once expressed his opinions upon Lord Avebury's list of the "hundred best books." Among those through which he dashed an angry pen, as objectionable and dangerous, was the *Origin of Species*. To him Darwin was "like a dim comet, wagging its tail of phosphorescent nothing across the steadfast stars." But truth must surely be better than falsehood. And if a given sun or planet were proved to be the centre of the universe, that physical relation, great indeed to think upon, would be nothing worth beside the smallest of the unselfish acts or noble thoughts of man. If the dwellers on that centre were merely beasts or blackguards, then Mother Earth and her brood would take precedence of them by right divine—however provincial her physical position in the cosmos. It is a matter of interest only remote and speculative to me how much headway they may have made in Mars; for I have one or two friends with whom I would dare challenge the best of any race on any planet, central or circumferential, in the universe. They establish our "place in nature" finally enough for me. There may be something better; at any rate I cannot conceive it. Why, then, should the possibility of its existence disturb my appreciation of what is noble in my fellows? Ages yet unborn will remember the nineteenth century for its establishment of the supreme theory of universal evolution —with its utter dispersion of man's ancient dreams concerning himself. I would have the men of the twentieth century to be remembered as well, and perhaps even more gratefully, by posterity. How we should respect the monkey if we knew that he had guessed the truth and had planned and plotted to make the most of his latent possibilities—that *we* might be! So, in a distant æon, ere the sun has grown too cold, may the transfigured men who wear our form—in what part of space, or with what friendly rivals and helpers on other planets matters not—but who have achieved all that our noblest have but dared to dream—may they look back on us and say, "The men of the nineteenth century found the truth, but the men of the twentieth looked before *and after*, and pined and strove for what indeed was not, but, by the promise of that truth, assuredly was to be."

THE CRADLE OF THE WEST

THERE was a tale, admittedly but a tale, of long ago, that had a classic beauty and a romantic *motif*. In the Cretan city of Cnosus, when Athens was a new and feeble name, there ruled the despot Minos; and in those days—some thirty-seven centuries ago—his flag and the figure of the *Labrys*, or double-axe, which was his tutelary deity, were supreme upon the sea. He employed an Athenian refugee, named Dædalus, who built for him a wonderful labyrinth (named after the double-axe), wherein dwelt a savage monster, half bull, half man, and it was called the Minotaur, or Bull of Minos. The infant city of Athens had fallen under the domination of Minos, and he exacted a yearly tribute of fair and youthful men and maidens, who were sacrificed to the Minotaur's appetite. But at length the hero Theseus, with whom Minos's daughter, Ariadne, had fallen in love, encountered and slew the monster; for Ariadne supplied him with a thread by means of which he trod the maze and made Athens free. Such was the tale.

It has often been the fate of the beautiful and romantic in history to fall victim to the modern spirit of historical research. Thereafter the idols of our fancy and the objects of our wonder take rank as, at most, but symbolical of truth. It has been so with the Arthurian legend—as we must now term it—with William Tell, with the individuality of Homer, and with many pretty fancies more. And there is always the ready plaudit for iconoclasm. To-day, however, there is a turning of the tables. The victory is with the supposed myth; its weapon the spade, its protagonist Dr. Arthur Evans, of Oxford, who has been digging, for some years, into a Cretan hill the latent possibilities of which were patent to his eye; and has written the first chapter in European history.

Cnosus, it appears, was the centre of the earliest civilization of Greece, and was the veritable cradle of the West. The King Minos of the story actually ruled there, in the stead of his grandfather, Minos I., who was distinguished for the justice of his rule, and who—to diverge into fable—with his brothers, Rhadamanthus and Æacus, was appointed, after his death, as ruler of the nether world—a Dantesque figure. The palace of Minos II., built by Dædalus, covered at least five acres. The plan of it has been reconstructed and readily explains its mythical conversion into a labyrinth. It is elaborate and complex in the extreme, with central and outer courts, state and public entrances, corridors and halls, council-chamber, bath-rooms, magazines, stone stair-cases, and sanitary arrangements, in 1800 B.C., much superior to those which troubled



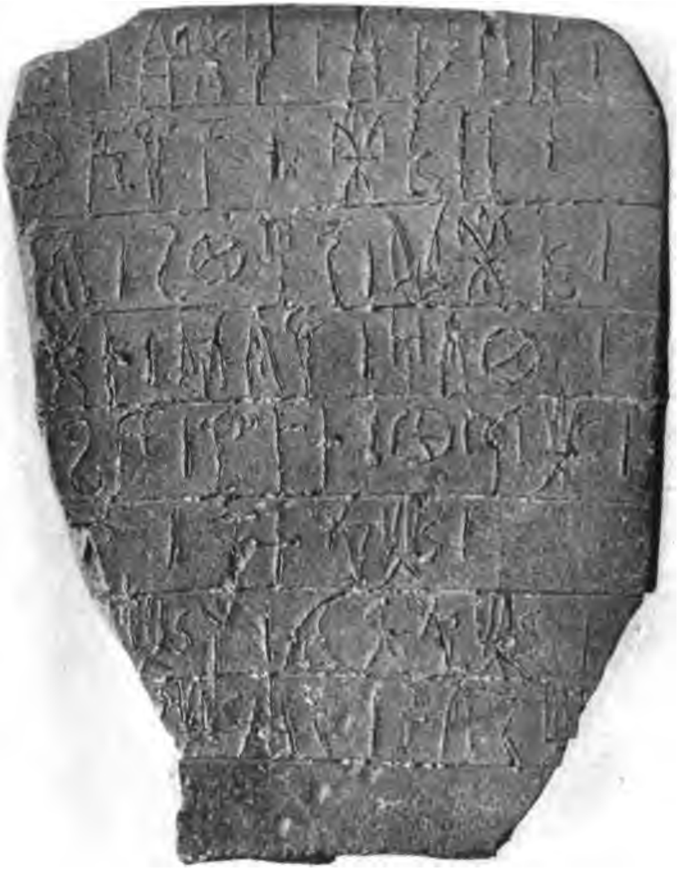
THE PALACE AT CNOSUS BUILT BY DÆDALUS

Northern border of palace, west of northern entranceway.

our immediate ancestors in 1800 A.D. Yet this palace was but the remodelled successor of still earlier royal dwellings which go back into the fourth millennium before our era.

Dædalus must have been one of the greatest of the sons of man, and we must look upon him as the first European genius. This "immortal mortal" was apparently the founder of high art and of mechanical science. He was a great sculptor and, though he guessed it not, seemingly the first anatomist. He was a greatly daring and successful architect and, not excepting even Moses the law-giver, the first hygienist, though the goddess from whom that word is derived was conceived of long after his day. He appears to have ventilated his master's palace in a manner much more efficient than anything known in the public buildings of to-day. The *Art of Dædalus* seems to have far exceeded the accounts of a later time—accounts which were, however, too glowing and too astonishing for credence. The wall-paintings of the palace deal with a host of subjects. They show that an extreme degree of constriction of the female waist, even in the professional athlete, prevailed in his day; as did the use of cosmetics, which, like the corset, were therefore inoculated into European civilization in its cradle. Bull-fighting, also, dates from Cnosus, and furnished many scenes for the genius of this Athenian slave. Besides the ivory statuettes—which have a far greater extrinsic interest, as I shall try to show—the sculpture included such pieces as a lioness's head in marble and a triton-shell vase in alabaster. Cameo-cutting, which after the destruction of the palace in the *fifteenth century before Christ*—think of it!—became an art for many generations lost, was practised, and very finely, by Dædalus and his pupils. He appears also to have imitated Egyptian art in porcelain, and it is to the Egyptian relics in Cnosus that we owe our knowledge of the approximate dates of the various strata through which Dr. Evans has dug. Hence we can say that even so long ago as about 2500 B.C., at the time of the twelfth dynasty, Cnosus was not merely in existence, but had reached a high degree of civilization, as is evidenced by the painted pottery of that date, delicately coloured, beautiful in form, and fine in fabric. So that even seven centuries before Dædalus there was art in Europe. But surely this astonishing man must be regarded as the original "Admirable Crichton." In sober history Leonardo da Vinci had hitherto carried off the palm for versatility, but now Italy must bow to Greece, and acknowledge Dædalus as the master of all trades. No wonder that the fable credited him even with the power of flight!

The results of Dr. Evans's spade-work in Crete have thus remade sober history—history made long ago in Crete, the easternmost island of Europe, and discovered, after four thousand years, by a native of its westernmost. This most distinguished digger of the soil, after manifold delays

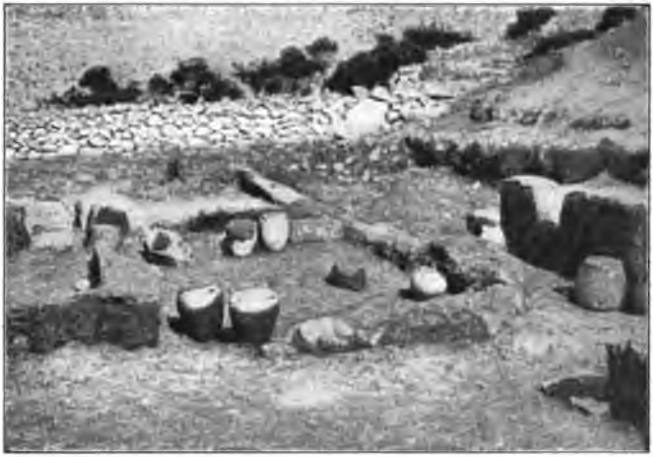


LARGE TABLET WITH LINEAR SCRIPT FOUND AT PALACE OF CNOSUS

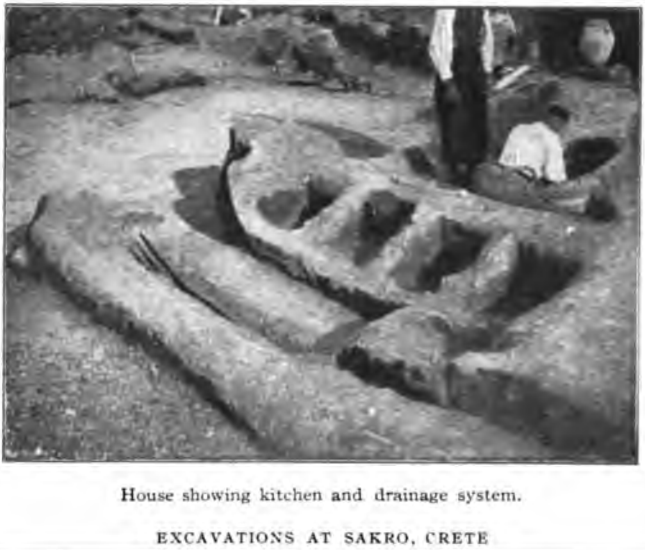
(Slightly reduced.)

and difficulties, has found, imbedded in the Cretan hill of Cephala, the astonishing proofs which have made history of the myth, and have revealed facts incredibly stranger than what sixty generations or more have regarded as fiction. But though Dr. Evans's work is not nearly finished and he is hard at it as I write, yet this is not nearly all. He has found certain clay archives and other records which illustrate the Minoan system of writing and probably throw much light upon the origin of certain letters in the Phœnician alphabet. The Greeks, we may remember, attributed their alphabet to Cadmus, the Phœnician, who, about 800 B.C., left the Syrian coast for Greece and founded Thebes, bringing with him (as his hosts' descendants believed) that supremest of present-day commonplaces, the letter. But Dr. Evans's discoveries have shown us —as we might have guessed—that letters were not invented, but evolved. Certain of the Minoan records are in the quasi-pictorial or hieroglyphic form with which Egyptologists have made us familiar, but others are *linear*. These latter have not yet been interpreted, and it is not certain whether the forms corresponded to letters or syllables— whether the Minoans had an alphabet or a syllabary. But it is highly probable that Cnosus saw a stage in the history of certain of the symbols which are before you on this page. Apparently there can be little doubt of this in regard to the evolution of the letter O from a rude representation of an open human eye. It is an interesting reflection that, at that distant day, the Chinaman wrote, as he does still, in pictures. Two divergent strokes — to represent the legs — mean a man to him, and, if he places beside them an oblong figure with a few lines radiating from it to signify a speaking mouth, he means, in our very metaphor, "a mans who stands by his word." One-third of the human race to-day uses a method which, in Crete, was superseded four thousand years ago. It is the superlative of conservatism.

To that date, therefore (while fully recognising the independent history of letters in Babylonia), we may now refer the evolution of letters on Cretan soil from a pictographic script, itself of Egyptian origin. Either there was direct intercourse between Crete and Egypt or the two were connected by Libyan intermediaries. The Cretan letters were, however, derived from the form of native — not Egyptian — objects, as well as from gestures, an admixture of gesture-writing with picture-writing being universal, found in every part of Europe, in Asia, and in North America. Some of these forms found at Cnosus, now definitely linearised, are almost identical with the letters of the Greek alphabet. In much of primitive Europe we had already seen evidence of pictorial writing; in the Nile Valley, throughout Syria, and in Asia Minor a more or less formalised pictographic script had been found; Schliemann had demonstrated a high degree of prehistoric civilization at Mycenæ and at Troy; yet until Dr. Evans began to dig at Cnosus



House showing vases found in one of the rooms.



House showing kitchen and drainage system.

EXCAVATIONS AT SAKRO, CRETE

it was believed that "pre-Homeric Greece was a stranger to writing, there being no trace either in the Peloponnese or the rest of Greece of anything before his time that even distantly resembled any kind of writing." The belief in "man before writing" so late as six thousand years ago he has dispelled. So much for Crete as the stepping-stone by which civilization passed from Asia to Europe—and some of us who are heirs of that civilization may look forward to visiting the museum at Candia where many of these treasures are fitly housed.

But I wish to introduce a new consideration which the study of Dr. Evans's photographs of the Cretan statuettes has forced upon me. Certain of the statuettes of flying youths and some others constitute the oldest exact anatomical records known—which is my excuse for calling Dædalus the first anatomist. Of course, we except Egyptian work which tells us that man walked upright long before Cnosus. That we could well have guessed. But Dædalus's work demonstrates this, that four thousand years ago, at least, the arrangement and mutual relations of the surface muscles of the forearm, and the manner in which the minute venules on the back of the hand join to form the main superficial veins of the arm, were precisely the same as in each of us to-day. But fully to realise what this means we must look at another question.

The first of contemporary anatomists, Sir William Turner, is never quite so happy as when, in that rich bass which has delighted students for nearly half a century, he speaks of "man the erect." Robert Louis Stevenson's genius added a couple of letters to his fellow-townsman's phrase, and made it twice as significant—"man the erected." Why, then, is man erect, what does the posture signify, and has he more to hope for?

Man is erect because a vertical line from the centre of gravity of his body falls behind his hip-joints. In the ape the condition is the reverse, so that the creature, even if he be a "Consul," always tends to drop upon his fore-limbs. Man, on the contrary, tends to roll backward at the level of his hip-joints. When you stand erect, you are prevented from rolling backward while your legs remain erect, because a strong ligament, the strongest in the body, passes from your trunk to your thigh-bone over the front of each hip-joint. If this ligament—named, after an American surgeon, the *ligament of Bigelow*—were severed, the earth would pull your trunk over and you would make obeisance in entirely novel fashion. In the lower animals these ligaments are much weaker, and their severance would be of little importance, since the creature tends in any case to fall forward.

This mechanical advantage depends on the peculiar curvature of the human spine, and especially upon that forward curve in its lower part which partly produces the "fall in the back," and which is a distinctively human characteristic, though there are the beginnings of it in the anthropoid apes. It is interesting to note that this extremely important "lumbar convexity" is better marked in woman than in man.

But the sinuous line of the adult backbone, with its four curves, is not present in the baby, which, in accordance with Von Baer's law, illustrates the past history of the race. The baby's backbone is a simple curve, *concave* forward. There is no lumbar convexity. The baby's centre of gravity falls in front of its hip-joints, and therefore the baby, even if it had the sense of equilibrium and the full control of its muscles, could only momentarily stand erect.

We must refrain from asking how this most essential change in equilibrium was produced, and inquire into its consequences. Man, thereby, was erected, and his horizon widened, in the literal sense. But was there no greater gain? Indeed there was; and here we reach a theory associated with the name of Professor Cunningham, Sir William Turner's pupil, who now fills his master's chair in Edinburgh. For millions of years the vertebrate had used all four limbs for locomotion. Though other uses there were, locomotion was supreme. But when the hind-limbs sufficed—when there appeared "man the erected"—the fore-limbs found their occupation gone. *Now* observe your Dædalus, your Joachim, your Rodin—nay, your Shakespeare. Was it not the endowment of two new and potent organs, with their sensitive fingers and—most important—their splendid thumbs (there are naturally no such thumbs below man), that, in serving their master, the brain, revealed to him his potentialities, and helped to make him what he is?

And why should there always be just a subtle change of timbre in his voice when Sir William talks of "man the erect"? The answer is to be found in his famous assertion that, physically, man is essentially perfect. This is what we mean. We do not say that man may not lose his hair and, perhaps, his teeth (which, already, often fall in the fight before we do), his nails, his noisome appendix, and quite a quorum of his toes. But we do say that for untold æons this thing that once crawled upon its belly has been nursing the hope "Excelsior." And now, at last, it can hold its head up in the world—oh, most wise metaphor!—its brain has come out top, above its backbone instead of in front of it, and its, or rather we should say *his*, horizon is veritably widened. For the first time, there is a creature that can take broad views—if it but will.

Physical evolution, in the gross, has stopped; and I take it that, at Cnosus, as Dr. Evans has revealed the evolution of the alphabet, and therein a phase of the evolution of the human mind and of the functions of the human brain, so he has added one more proof, by unearthing these beautiful and significant statuettes, not so much of the slowness of physical evolution as of its essential completion many thousands of years ago. And so it is. Nature has given this particular planet over to the vertebrata, and to them, early in their history, she granted four limbs. At first used for progression alone, these became gradually differentiated in function, until, in the *finale*, a series of modifications in the vertebral curves, hurriedly epitomised by every infant to-day, permitted man the erected to walk erect. Spared from locomotion, his fore-limbs have made of him even a Dædalus, the Admirable Crichton of four millennia ago. These venturesome limbs may, indeed, have subtly urged forward the cerebral development which is the mark of our race. But there are no more limbs to spare. Our eyes are placed before and not upon our spines, our physical horizon can be no further widened. Physical evolution, properly so called, is an accomplished fact.

The elimination of the superfluous, referred to above, is only a by-way of the process which has made of the free-swimming single cell of the sea a hundred million years ago the man of to-day. That process, for so many ages in climax, has reached in us, or rather in our far ancestors, its physical acme. But, though since their day we have learned and ceased to write in pictures, and to talk in gestures; though we write in letters and talk in words, and make the ether carry them for us; though we have evolved systems of government which owe little enough to Minos; though we recognise a system of ethics the germ of which was not in Crete nor yet in Egypt, we have yet to traverse an infinite vista of evolution in another and a loftier plane. The evolution of the cortex of the cerebrum has not stopped. Do you imagine that mental and moral evolution, begun but yesterday, can yet enable us to conceive more than a dim foreshadowing of the grandeur of their goal?

THE WORLD IS YOUNG

THE world itself, of course—our planetary prison—is not young. Rather is it old. We call this year the year 1904, as some approximate indication of our distance from the most important event in human history. One other date is comparable, in interest, to that—the date of our earth's first revolution around the parent sun. If a "year" be the period of one revolution, what is the real number of this year? We cannot say. Certainly the moon, as Professor George Darwin has shown, is at least fifty millions of years old, and she was born long after the parent earth separated from the solar patriarch. The crust of the earth, according to another calculation, has probably been solid for more than a hundred million years. How much older the earth is we cannot say, nor how long it will be before she returns, like the prodigal, to the sun. Nor can we say what proportion the years that are past bear to the years that are to come. This manner of statement is, indeed, unscientific, for Professor Darwin has shown that the year is lengthening by about twenty-two seconds in each century, and is not a constant measure of time. At any rate, let us gain the clear conception that the life-history of the earth extends from the first second of complete detachment from the solar nebula to the inevitable though distant moment when she touches and becomes reincorporated with the then dull and sullen mass that roams forever, yet ever marks the immovable centre of gravity of the system that bears his name. And we must conclude that the world is very old, at any rate if we estimate its past by our common standards. It is probably old, or at least middle-aged, if we regard it as a being with a life-history. Perhaps half its course is run; but the recent discovery of radium and radio-activity must lead even the wisest mathematical astronomer to make his statements guarded and tentative, for we are now acquainted with a source of energy hitherto unknown, and likely to have played a very considerable part in the evolution of the earth, making the probable length of its past history much greater than was formerly supposed.

But if we take the world to mean the society of man—some day, perhaps, to form a new and all-embracing "Society of Friends"—if we complete the alliterative phrase and mean "the world and his wife," then the world is young. I will not wait to discuss the varying senses, observed by Tennyson, in which the words "young" and "old" may be used in this regard. We talk of the "old" times, but the moment of reading is older than the moment of writing these words. The race was never so old as it will be to-morrow. If we come to consider figures, we must clear our minds of any absurd ideas about the "first pair," the "cradle of the race," and so forth. The transition from some tailless "old-world" ape to man was a matter of many generations, displayed in the descendants of many pairs and not of one. But we may adopt as an approximate figure for the age of man a period of two hundred and fifty thousand years, which is believed to have fair claims to provisional acceptance. Obviously the term "man" needs definition; and precisely to define it is as obviously impossible. Every distinction, formerly supposed to be absolute, between man and his predecessors has long ago broken down. Remembering the recent evidences of the presence of an incipient speech in certain of the higher apes, we need not even predicate the existence of a *homo alalus*, or "man before speech." But, begging all these difficult and interesting questions, we may assume that a creature which may fairly be called human began to live upon this planet about two hundred and fifty thousand years ago—more or less.

Now, if we look forward, we may consider the calculations based upon the rate of solar shrinkage and other data, which seem to suggest a period of about three millions of years during which animal life will continue to be possible on the earth. But there is not the least need to admit for one moment that this, or any other figure, may be taken as representing the inevitable. There is, I verily believe, no inevitable in this matter. In a recent essay M. Maeterlinck has suggested that, in a few centuries, man may have learned the secret of gravitation, and will be able to steer his planet where he pleases. But in order to extend this suggested period of three millions of years, it is not necessary to suppose any such advance of knowledge as this. While freely granting that he would be foolish who should venture to assert that man will not one day be able to control his own destiny in this and a thousand other ways, we need not invoke any extension of human knowledge at all. We do not yet know whether there is any radium in the sun. The spectroscope does not detect it; nor do chemical solutions exposed to sunlight and known to be affected by the radiation from radium. But this may be because the characteristic rays are absorbed by our atmosphere. On the other hand, there is good reason to believe that there may be radium in the sun. We know that, as its name suggests, there is helium in the sun. We knew it there long before it was found in cleveite upon the earth. We also know that helium is produced on the earth by the evolution of radium—a discovery made by Sir William Ramsay and recently confirmed in St. Petersburg. Hence the probability that the solar helium is also derived from radium. Further we know that the geologists demand, for the formation of their strata, a far longer period of time than the physicists—until the discovery of radio-activity—were willing to allow them. Ten years ago, at the meeting of the British Association at Oxford, the late Lord Salisbury seized upon this discrepancy as an argument against the theory of evolution, in his famous presidential address. The discovery of radio-activity seems to go far in solving this difficulty, and, while it adds indefinitely to the past age of the sun and the earth, it adds we cannot say how much to the future duration of our luminary as a source of light and heat, and therefore to the probable length of the period during which man, even without any further extension of his knowledge, will be able to endure upon the earth.

But it is quite sufficient for my purpose to take this figure of three millions as an accurate one; and the more it falls short of the truth, the more cogent will the argument be. Assuming, then, that these two figures—two hundred and fifty thousand and three million years—approximately indicate the facts, we may take it that the human race has completed only one-thirteenth part of its history—while remembering that the fraction should, in all probability, be much smaller still; if not, indeed, an absolutely negligible or infinitesimal quantity—remembering M. Maeterlinck's prophecy.

The world of men is, therefore, very young indeed. But it is only fair to modify these figures and endeavour to obtain some idea of the date when man became self-conscious; for from that date begins the history of the race, in perhaps the most valid of senses. The estimation of this later date is largely a matter of guesswork, but certain criteria we may find. One writer, I believe, has indicated some such period as twenty-five thousand years—a date some fifteen thousand years or more before the earliest-known Babylonian records. Another theoretical method of estimating the length of time during which man has been self-conscious occurs to me, but I gravely question its worth. We know, of course, that the history of the individual is a recapitulation, in brief, of the history of the race; that "Ontogeny is the recapitulation of phylogeny." This concept, doubtless through the work of Spencer, to whom Stevenson, like George Eliot, was so greatly indebted, was known to the Scottish novelist, as the pages of *Olalla* and the *Memoirs of Fleeming Jenkin* bear witness. Now if we had some time-table which would indicate the correspondence between the stages in the development of a child and the history of the race we might find a key to the present question. If, for instance, a child became self-conscious at five years, and the normal period of development was twenty years, we might get some key to the date at which the race (the individuals of the race, that is) became self-conscious. But it is not so easy to say, to begin with, when a child does become self-conscious. Tennyson, of course, has told us, in "In Memoriam," that "the baby new to earth and sky . . . hath never thought that this is I," but he gives us no further light. The question, of course, is old, but I have not seen any particularly convincing answer. So with this initial difficulty the argument must cease for the time, and meanwhile let us assume that man has been a self-conscious creature for twenty-five millennia. By self-consciousness is meant, of course, consciousness of self. If we take, then, this fundamental but illusive antithesis between the ego and the non-ego as our standard, we may say, in round numbers, that man, the animal with a point of view, is twenty-five thousand years old and has yet three million years to go. He is, therefore, very young indeed, for the proportion between these figures is as one to one hundred and twenty. Man, roughly speaking, is now a semi-articulate babe—not literally an infant, but very newly promoted from that state—of one year old; unless something very improbable, such as a cosmic collision due to gravitation, happens in the interval, he will live to be at least a centenarian.

So you see that there was some reason in Tennyson's wish that, once in a century, he might revisit the glimpses of the moon, and see how the world was going on. For we are in the very dawn of time. Archimedes and Hero's engine and Democritus have caused many to forget how young science is. Sir William Crookes, indeed, has gone to the other extreme and forgotten the Greeks altogether, if we may believe the report of his statement, made at Berlin not so long ago, that Englishmen were the first to inquire into the nature of matter. The centenary of Dalton had surely dazzled him. But science as we know it is really very young indeed—three centuries, indeed, we may say. The *De Magnete* of William Gilbert, of Colchester, physician to Queen Elizabeth, is said by Professor Sylvanus Thompson to mark the first coherent assertion—earlier even than Bacon—of the inductive method, the method of argument from facts to theories and not *vice versa*. In the final establishment of the *a posteriori*, or inductive, method of reasoning as the primary weapon of science, we may find the beginning of the scientific epoch. I have not forgotten Copernicus and many more, but they do not invalidate the statement that science, or "organised knowledge," as a factor of proper importance in human affairs, is only three hundred years old.

Gazing down this all but illimitable vista which modern science has revealed to us, one is tempted, as so many have been tempted before, to speculate. If we remember that the human mind itself is still, of course, in process of evolution, we may realise how puerile—in a very proper sense—are its efforts to forecast what it may achieve in time coming. It is the evolution of the mind, of course, that will determine the future more than any other factor can, for are not religion, science, literature, and art the "objective register of subjective changes"?

And in this connection one may perhaps venture upon a prophecy. However mind may advance, every consecutive generation, as far as we can see, will have to begin at the beginning. It would, therefore, be an immense advantage to humanity if the average period during which any individual mind is available with the added value of experience were greatly lengthened. Now science is already steadily lengthening the average expectation of life in all civilised countries. There is no doubt whatever that gross disease will be utterly abolished in the years to come. By far the greater part of disease is produced by bacteria; and we cannot doubt that the process already begun, in the case of malaria at Ismailia and elsewhere, and in the case of yellow-fever by the American army surgeons after the occupation of Cuba, will be continued until the last pathogenic microbe has been extirpated. The present most important aspect of bacteriology will be purely historical, and the science will be developed in its industrial relations. With the abolition of disease and the great increase in the average duration of human life, together with the avoidance of the great waste of human energy involved in the present appalling infantile mortality, the human mind will have far greater opportunities than have hitherto been afforded it, every part of the world possessing its hundreds of sages, eighty or ninety years old, whose experience and decade-long thought will rival that of such a contemporary anticipation of them as Lord Kelvin. Man's command over the forces of nature having reached an efficiency not yet dreamed of, there will come, as I have tried to show in another essay, an epoch as different from the present industrial era as that differs from the military eras of the past, and more immeasurably superior.

There is plenty of room for speculation here, is there not? Man is only one year old just now; he will have other requirements and somewhat different habits ere his end. The world is very young.

THE DESTINY OF THE HORSE

The great poet and biologist Goethe, himself a forerunner of evolution, was struck by the pathos of the horse's foot, with its five toes "glued together." But subsequent research has taught us that the primeval horse submitted to no such process. He was a typical vertebrate, having ten fingers and ten toes. Upon these he walked in the American continent long ago—not upon his palms and soles. He is, therefore, styled digitigrade, not plantigrade. Complete skeletons of him, at this earliest stage, have been found in the early Eocene deposits at Wasatch, in North America. The fossil form, named Phenacodus, had been already unearthed. But, as the ages passed, the horse found that it was more to his purpose to let some of his fingers and toes go; he was content for some time with four instead of five, then with three. It is at this stage that the European evidence begins. In the early Miocene deposits a three-toed horse is found. In the later Miocene a further stage is reached; only the middle finger and toe touch the ground, while the lateral fingers and toes are becoming shorter and shorter. The four-toed was only a short stage in descent. The horse belongs to the odd-toed section of the hoofed or ungulate mammals. The even-toed, or those of the "cloven hoof," have another pedigree. In the horse of to-day and many past days, the middle fingers and toes alone remain. His knee is the homologue of man's wrist; his "cannon-bone" answers to the middle bone of the palm of the human hand; the "pastern," "coronary," and "coffin" bones answer to the three bones of the middle finger; and the hoof is its nail. The "splint bones" represent our second and fourth fingers, and some small bony prominences at the bases of these correspond with our thumb and fifth finger. The case is similar with the hind-legs. The modern horse, therefore, walks upon the tips of the nails of his middle and only remaining fingers and toes. In an American museum you may see the entire series without a break, from the five-toed horse to the horse of to-day, nor is it possible to say, so complete is the series, that at any particular point a line of demarcation may be drawn.[1] There is not a gap in the slow history of the horse's descent. The extreme significance of all this is that, nearly thirty years ago, it demonstrated for the first time the fact of evolution of an extant species, and the direct line of descent of an existing animal. The tale is complete that links the one-toed genus equus of to-day with a five-toed ancestor which was common to it, to the tapir, to the rhinoceros, and to other hoofed quadrupeds.

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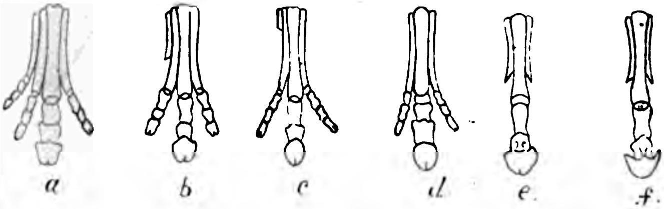
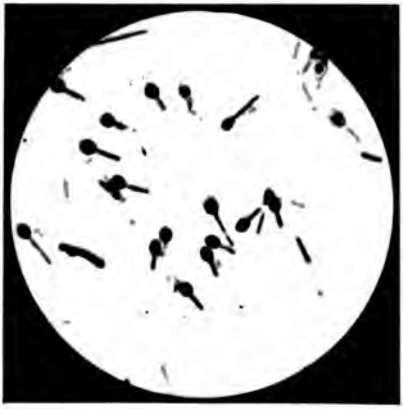
[1] See illustration facing this page.



FOREFOOT OF ANCESTRAL FORMS OF THE HORSE

a. Orohippus.
b. Mesohippus.
c. Miohippus.
d. Protohippus.
e. Pliohippus.
f. Equus.



BACILLI OF TETANUS

THE DESTINY OF THE HORSE

For many generations the horse, as we know him, has been the friend and servant of man. Four thousand years ago, or thereabouts, the author of the Book of Job sang his praises: "Hast thou clothed his neck with thunder?"; long afterwards the inventor who wrote the first page of the last chapter but one in the horse's history, utilised the horse's strength as a means of measurement, but made the unit, the "horse-power," just one and a half times as much as it should have been. Slowly the steam-engine has developed and been followed by petrol and electricity and underground cables, until a royal commission sits upon London locomotion, which is typically out of date. Soon the dust of our streets, in which blows the deadly plant—the tubercle bacillus—that slays one in six or seven of mankind, will be freed of the far less objectionable element due to the horse. Meanwhile horse-hair has become invaluable in surgery, and the horse's blood invaluable in medicine. Soon the wretched bus-horse will be unknown. For the astonishingly complex and incomprehensibly rapid chemical changes which occur when a muscle contracts—changes in motor nerve-cells in the brain and in the nerves leading therefrom, in the motor nerve-cells of the spinal cord and the nerves leading, in their turn, from them to the muscle-cells, and in those contractile muscle-cells themselves—for all these we shall have, everywhere, a column of steam or a dead dynamo. The horse's muscles are long ago superseded—for man's purposes, that is to say.

But he has within him a living laboratory which no dead forces can emulate. Observe the horse of tomorrow, when his powers are really understood, when his ultimate and unique possibilities are realised. Freed from mere muscular toil, cared for as by the Arab of the desert, splendidly housed, liberally and regularly fed, he will be used for an end worthy of his ancient lineage, his beauty, and his countless virtues. He will be made—he has already been made—to bear our children's diseases for them. The vicarious burden is nothing upon his noble shoulders. It is the easiest, as it is incomparably the most wonderful and the most valuable service that the horse has ever rendered to man. It is a worthy acme to the long climax of his history; even though that includes the furnishing of the final proof of the theory of organic evolution.

Cultivate from some unfortunate child's throat a colony of the bacilli of diphtheria. They can be conveniently grown in ordinary test-tubes containing some kind of culture-medium, such as agar-agar, beef-jelly, and so forth. After a time liquefy and filter your cultures, so that the bacilli remain behind, while the poison they have meanwhile produced passes through. This poison—the diphtheria toxin—inject through a hollow needle under the horse's skin. It is a bagatelle to him. His body-cells, easily and without any hurt, produce an antitoxin which unites with and neutralises the toxin which the bacilli have formed. But fortunately this is not all. As is usual in germ-diseases, whether occurring naturally or artificially imitated, there is an *overproduction* of antitoxin, much more being produced than there is toxin present to combine with. Hence the blood of the horse comes to contain a quantity of free antitoxin.

Exactly the same process is going on in a child's throat somewhere else, but the antitoxin is insufficient, the bacilli are winning, the child is dying. Open a vein, one of those beautiful sinuous veins on the horse's leg, remove a few drops of blood containing the antitoxin, inject them under the skin of, say, the wrist of the choking child: in a few hours it draws the grateful breath of convalescence. Hurriedly epitomised, this is the antitoxin treatment of diphtheria, which humanity owes to Klebs and Löffler, who discovered the organism, to Roux and Yersin of the Pasteur Institute, to Von Behring and Kitasato, and primarily, of course, to the great French chemist Pasteur. This is going on all over the world at this hour. The whole process costs the horse nothing. He will not deign to turn his head or stop champing his hay during your pin-pricks, and he leads a princely life for his trouble. The antitoxin he supplies has revolutionised the whole aspect of diphtheria.

It is a most unfortunate fact that the value of this life-saving measure has been partly interfered with by those who object to the means which make it possible, and one of whose methods is consistently to deny the utility of any knowledge gained by such means. In order to decide whether the blood of the horse does really save our children's lives, let us therefore look at the statistics recently quoted by the Lister Institute of Preventive Medicine in London. They show that, in the Metropolitan Asylums Board Hospitals, since the year 1895, when this treatment was begun, the percentage of mortality has steadily fallen as the percentage of cases treated with the antitoxin has risen. In that year 61.8 per cent. of cases were so treated, the mortality among all cases being 22.5 per cent. In 1901, as for some years before, *all* the cases were thus treated, and the mortality, which had been steadily falling for the six past years, had reached the figure of 12.5 per cent. These results are not nearly as good as they might be, because the blood of the horse is not invoked soon enough. At the Brook Hospital the mortality of cases thus treated on the first day was 0.0 per cent.; on the second day, 4.1; the third, 11.9; the fourth, 12.4; and thereafter, 16.6. The collective investigation of the American Pediatric Society gave the following percentages for the first five days: 4.9, 7.4, 8.8, 20.7, 35.3. Parallel figures have been sent in from Austria and Germany and every other civilised country. Treated on the first day, hardly any case, if any, will not recover. The doctor need not calculate the dose in proportion to the age, or rather the weight, of the child. He is dosing the bacilli, not the patient. So he gives the same dose to every case. Tracheotomy is so rarely necessary that the doctors are almost forgetting how to perform it. The horse has already rescued thousands of children, all the world over, since his high destiny, after so many millions of years, was thus achieved.

I ask whether this is not a worthy reward for his millennia of labour in our behalf—for the myriad brutal blows; for the knacker's yard; for the rude omnibus, the cavalry charge, and the race-course: that such work should be relegated to inanimate machines—machines which man can make with his own hands, and that the horse should lead a life of useful and honoured luxury, while the exquisitely subtle and inimitable chemistry of his living cells saves our children's lives.

THE CONTRIBUTIONS OF JAPAN TO MODERN SCIENCE

WE hear much nowadays of the rapidity and facility with which Japan has adopted Western civilisation; and she is rightly admired therefor. It is, indeed, a good hap that provided her with chloroform and carbolic acid—with modern surgery, that is to say—ere the beginning of what promises to be a long campaign. It is not possible for us to conceive what chloroform means to the soldier. Here is a merciful anæsthetic, easily administered, needing no apparatus whatever (unlike ether), certain in its effects, and so powerful and concentrated that the question of porterage hardly arises. What agonies it is now abolishing in the far East who can say? and for this agent Japan owes a debt to a man of a far-distant race, who risked his life in anæsthetising himself with it, fifty-seven years ago, in an Edinburgh dining-room. No less great than its debt to Sir James Simpson is its debt to Lord Lister, the founder of modern surgery.

But it has not all been mere adoption and imitation on the part of Japan. In the science of relieving human suffering, I have quoted two discoveries, made by a Scot and a Yorkshireman, which will save thousands of Japanese—and Russian—lives, and will relieve immeasurable agonies in the present campaign. But, confining ourselves to the records of that same branch of science, we may easily discover that we, too, are in Japan's debt for several very notable discoveries, which have already saved many European lives. Certainly no one would say that they take rank with anæsthesia and Listerism, but they are noteworthy additions, nevertheless, to the war-stores of the healing art.

The oldest of these is the isolation by Kitasato, a Japanese bacteriologist, of the bacillus that causes lockjaw, or tetanus.[1] Now, if there is any branch of science that requires patience, manual and ocular dexterity—if one may use the phrase—and a genius for details, it is bacteriology. Any one who knows how Pasteur, its founder, discovered the life-saving treatment of hydrophobia, or who has read the history of Koch's successful search—rewarded after many years—for the tubercle bacillus, will agree with this assertion. And these are typical Japanese qualities, as their art abundantly proves. The most dextrous dissector the writer ever met was a Japanese, and the surgeons of Japan are second to none. Therefore it is not surprising that we owe to them the isolation in pure "cultures" of the *bacillus tetani*—it had already been found, but not isolated, by Nicolaier; nor did Kitasato stop here. Working with Von Behring, the great German bacteriologist and founder of serum therapeutics, Kitasato showed that the blood serum of an animal which had been immunised against tetanus was able, when injected into other animals, to protect them against tetanus toxin and even against living tetanus bacilli. Hence Von Behring and Kitasato were able to produce the tetanus antitoxin which is now invariably used—when it can be obtained—in the treatment of lockjaw, and which is by far the most efficient remedy known to medical science for this terrible disease. It has already saved many lives since their famous research in 1890.

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[1] See illustration facing page 176.

But this by no means exhausts the list of positive achievements which stand to the name of Kitasato. To him and Von Behring we also owe the antitoxin treatment of diphtheria, which is the greatest therapeutic advance of the past decade, and has already saved many thousands of lives. In this case the bacillus was known, having been discovered by two German bacteriologists, after whom it is called the Klebs-Löffler bacillus. Kitasato and Von Behring succeeded in obtaining from the bacilli their toxin, and in treating the horse with it so as to produce, in the animal's blood, the antitoxin which now daily saves children's lives all over the world. No one but a professional bacteriologist knows the difficulties that must be overcome, the thought that must be expended, the discrimination and precision that are necessary, for the now-attained consummation of such a series of researches. And in the history of an achievement equally important from the point of view of science or of human lives, the name of Kitasato stands second to none. It may be observed that this piece of work demanded a much higher order of intelligence than do many scientific discoveries. It is a mistake to imagine that bacteriological work is essentially of a " finicking" nature, needing no powers of thought, but merely patience and manual dexterity. Much resource and inventiveness — a low form of "constructive imagination"—are also necessary.

But Kitasato is by no means the only Japanese bacteriologist that has achieved fame. A year or two ago a fellow-countryman of his, Dr. Shiga, discovered the bacillus which causes a great many cases of dysentery, and since it was already known that an amœba (an animal and not a vegetable organism) was the cause of many other cases, pathologists are now able to divide this terrible affliction of the soldier in war-time into *amœbic dysentery* and *bacillary dysentery*. But we have lately been informed that Dr. Shiga has met with success in taking the step which is now expected to follow the discovery of any disease-producing, or *pathogenic*, microbe—that of preparing from it an antitoxic serum. This is now being produced in Frankfort, and just as Dr. Kitasato was able to obtain the anti-diphtheritic serum from the horse, so Dr. Shiga has been able to obtain his anti-dysenteric serum from the same animal. It is probable that this discovery will lower the dysentery death-rate—on both sides, for science takes no cognisance of race or frontiers—in the present terrible campaign.

A more recent Japanese discovery in physiological chemistry is really more interesting, because it raises newer problems. There is in the body of each of us a pair of organs known as the adrenal glands; yet unknown to the public, though life could not continue without them. It is a curious fact, by-the-way, that the public has heard of the stomach—which is the least important of the digestive organs, and which many people are now living without in perfect comfort—yet has never heard of the pancreas, which is the digestive organ *par excellence*, and which is essential to life quite apart from its digestive function. Occasionally we consume, as a dainty, an animal's pancreas, which we call a "sweetbread," but we never suspect that without our own sweetbread we could not live for more than three weeks. Similarly the adrenal glands, without which we would die in an even shorter time, are not known to public fame. It was a Japanese physician, Dr. Takamine, of New York, who isolated from these glands the invaluable substance which they produce for the benefit of the rest of the body. It is known as adrenalin, and nearly every sample of it, if prepared by a good firm, bears upon it the name of that distinguished Japanese. I have not space here to discuss the normal rôle of adrenalin. I would only say that if there were none in your blood just now, you would not have the muscular strength to sit in an easy-chair, far less stand or walk. But the most remarkable influence of adrenalin is on the blood-vessels. A solution containing one part of it in a million will contract the microscopic blood-vessels in the foot of a frog so that you can no longer see them. Hence it is the most powerful of all chemical agents for stopping hæmorrhage. It will arrest bleeding from the nose when everything else has failed: not that that much matters, for the nose is accessible to mechanical means; but adrenalin has already saved many lives that were oozing away in a thin, red stream no surgeon could reach. I wonder how many Russian soldiers' lives will be preserved by it during the present war, to enable them to fight against Takamine's fellow-countrymen? Not that they will know their saviour's name or race.

The foregoing studies, to which the most recent addition is Nokuchi's work on snake-bite, all deal with the science of medicine, which the practical Japanese have taken up with special earnestness. In this connection it is of interest to remember that it was European medicine—certainly not a very remarkable quantity at that time—which first led the Japanese to study a European language. That language was Dutch; and certain linguistic Japanese acquired a knowledge of it so that they might acquaint themselves with foreign medicine, which, even at that time, some centuries ago, they recognised as superior to their own. It would be quite a mistake, however, to imagine that the Japanese had no science, medical or other, until they imported the Western product. According to a recent Japanese writer, Mr. Naohidé Yatsu, "in so remote a time as the eighth century a university had already been established in Japan that included such modern divisions as schools of medicine, ethics, mathematics, history; and some of the text-books employed at that period dealt with such subjects as the diseases of women, *materia medica*, and veterinary surgery—types of text-book which appear to have been unknown in European countries until about one thousand years later."

As an illustration of Japanese activity in mathematics—to choose a deductive and exact science which is furthest removed from medicine—we may take a recent monograph by Professor Nagaoka, of the Imperial University of Tokio.

The title of the paper is "On a Dynamical System [that is, an atom] Illustrating the Spectrum Lines and the Phenomena of Radio-activity." We talk of the spectrum of radium, as of other substances, and describe the various colours and bands and lines, and so forth, seen in it. We measure, number, and compare them, thereby obtaining means of identifying traces of the element or searching for evidence of its presence in the sun, and we owe thanks to such workers as Sir William and Lady Huggins, who have instructed us on these points. This is all very well so far as it goes, and we may, perhaps, be inclined to call our knowledge scientific—as it is, in the popular sense of that word. But, after all, this is no more than empiricism—no more than the making of careful observations. We are not entitled to call our knowledge scientific in the proper sense unless we are prepared to address some sort of answer to the critic who may very properly ask us, "But *why* do these lines and bands occur? Your observations must doubtless have taken a lot of trouble to collect and record, and I quite admit their value; but can you tell me nothing as to the reasons why a collection of radium atoms should produce this particular spectrum and no other? Has it never occurred to you to inquire what it is in the structure and economics of the radium atom that *causes* these special features which you are so proud to recount?"

Most just criticism is this. Merely to have observed such and such a spectrum is no more science than it is merely to have observed that opium relieves pain. But medical science has advanced a little further. At any rate, it can isolate morphia from opium, and can prove that the morphia acts on the cells in the pain-perceiving areas of the surface of the brain. This is a stage towards the knowledge which shall write a chemical equation showing the reactions between the morphia and certain of the cell-constituents. Similarly Professor Nagaoka's paper gives us a mathematical connection between the structure of the radium atom, as he conceives it, and the characters of the spectrum which that atom produces. It is significant of the unity which is the key-note of modern science that this Japanese physicist was led to his theory of the radium atom by a study of Saturn and his rings.

Taking these instances of recent Japanese contributions to science, we may surely conclude—as we might have concluded for totally different reasons—that the Japanese mind is an appreciable and valuable item in the assets of the human race. The rest of the world already owes a great deal to Japan, in science as well as in art. Western nations may congratulate themselves on their latest ally in the sempiternal conflict between knowledge and ignorance.

And if we take a still more general view, and accept the teachings of archæology and anthropology, we may learn that our somewhat contemptuous phrase, the "wily Mongol," expresses something short of the truth. Mr. Foxwell, formerly Professor of Economics in the Imperial University of Tokio, expressed the facts very well at the end of a course of lectures on Japan recently delivered at the Royal Institution. Take a typical Western scene, such as the interior of an aerated-bread company's shop in London any afternoon. The visitors are drinking tea, and many of them are reading the papers. The tea, the china out of which it is drunk, and the papers we owe originally to the Mongol. Nor do I see why we should dislike to recognise our debt to other peoples. If one-third of the human race has qualities which make it useful to the rest of humanity, and if there is no sign of the disappearance of that fraction, should we not rather be thankful to see in it features which may tend to increase the sum of human happiness in time coming?

THE FUTURE OF THE MONGOL

THE present war raises some biological problems of the gravest possible character, so that one may attempt to consider them, despite the large proportion of speculation that is involved. And even granting the dubiety of many of my assumptions, the questions involved are of a general truth, which is incalculably important, and independent of the validity of any particular illustrations.

Following the late Sir William Flower, anthropologists and ethnologists agree that mankind are divisible into three great branches—the Caucasian, the African, and the Mongolian. The Caucasian may further be subdivided into the Aryan or Indo-European and the Semite. At present he dominates the planet. It is difficult to see how the African can enter very largely as a factor in the determination of the coming race. But the case is far different with the Mongolian, whose numbers and whose natural characters make him an object of very high importance to those who are interested in the future of humanity. Let us see whether we can take a broad view of him.

The Mongolian race may be regarded, from our point of view, as divided into three sections, and it is of some interest to observe the present state of each of these. At some distant period there migrated eastward from the birthplace of humanity—probably in western Asia — the ancestors of the Mongolian. Those who travelled farthest are at this hour on the verge of extinction. The most familiar types of this disappearing class are the Red Indian and the Aztec. We may form two theories of the cause which led certain members of the yellow race to leave Asia and cross over into North America. The first idea that occurs is that these were the most enterprising members of the race, who sought "fresh woods and pastures new," while their fellows were content with their native Asia. On that assumption there would seem to be something anomalous in the present fate of their descendants. If these were really the fittest of the Mongols, how is it that their sun is setting, while the star of certain of their cousins is in the ascendant? The influence of environment it can hardly have been, for the American continent has now been found to form a very fitting home for the human race. I think another theory offers a better explanation of the facts. It is suggested to me by what I conceive to be the analogous case of the whales and other marine mammals, such as the fur-bearing sea-lion and the seal, which, we are told, are undergoing a similar process of extinction. These, we may guess, did not betake themselves to the water because they had an exceptional native endowment of enterprise, but because they were ousted from the land by the force of competition. They have done their best to adapt themselves to their new environment. They have dispensed, in large degree, with their useless limbs, and have developed new features, such as whalebone instead of teeth, but the struggle is proving almost too much for them. So I incline to believe that the Mongols who passed over to America were probably driven there by *force majeure*, being the least capable and efficient members of that race.

The two other sections of the yellow race are obviously the Chinese and Japanese. The former are the stay-at-home, conservative race. The main-land was good enough for their ancestors and is good enough for them. But the case is different with the progenitors of the present Japanese, who are probably the most interesting people, from the scientific stand-point, extant in our time.

Among the many analogies between the Western Islanders of Europe and the Eastern Islanders of Asia, peoples occupying symmetrically disposed positions on either side of the greatest mass of land on the earth, there is also this, mean what it may, that they are both of a mixed origin. As regards ourselves, every one is familiar with the facts, which are among the few of any significance that we learn in history at school: not that the significance of them is there pointed out or even recognised. And though the Japanese can probably boast not quite so mixed a descent as our own, and though they show, at the present day, much more uniformity of type than we do, yet the ancestry of this consistently dark-eyed, black-haired people is of considerable complexity. The Ainos of Yedo, the aborigines of the Japanese islands, are certainly represented in the modern Japanese. Where they came from, how long ago they reached the islands from the Asiatic continent — islands which the geologist recognises as having been produced by a volcanic upheaval — we will not inquire. At any rate, they may be taken as representing one strain in the Japanese of to-day. Another such is quite certainly Chinese, another is Korean, and a fourth unquestionably Malayan. Probably Papuan invasions did not affect, in any appreciable measure, the composition of the race, which would, of course, have suffered thereby.

We may take the modern Japanese, then, with their quickness of thought and corresponding quickness of act, their marked adaptability to change of environment—as proved by their rapid and successful adoption of Western ideas, and their very high and enviable ethical sense, as typifying some of the good results which all biology has proved to result from judicious cross-breeding. Needless to say, it would require much more knowledge of the historical aspect of the subject than we possess, and much more study than any one has yet given it, to enable us dogmatically to assert that this mixture of race is the real cause of the difference between the Japanese people to-day and their neighbours, the Koreans and Chinese. At any rate, whether this be so or not, biology clearly asserts that it might be so. Such a result as we see in the Japanese or ourselves is the result that should follow the happy commingling of peoples sufficiently different yet sufficiently allied.

Biology teaches us that these words, *sufficiently allied*, are of the utmost importance. For well we know that while inbreeding--purity of race—ultimately leads to that degenerate state illustrated by such of the monarchies and aristocracies of Europe as have not been saved by the very events of which they are least proud, yet we know with equal certainty that consequences the most lamentable follow the admixture of races *too diverse.*

This is the fact which induced Spencer to warn the Japanese against the results of intermarriages with the Aryan races. I quote the words addressed by this master in biology to a Japanese aristocrat in 1892:

> "To your remaining question respecting the intermarriage of foreigners and Japanese, which you say is now very much agitated among our scholars and politicians, and which you say is 'one of the most difficult problems,' my reply is that, as rationally answered, there is no difficulty at all. It should be positively forbidden. It is not at root a question of social philosophy. It is at root a question of biology. There is abundant proof, alike furnished by the intermarriages of human races and by the interbreeding of animals, that when the varieties mingled diverge beyond a certain slight degree *the result is inevitably a bad one* in the long run. I have myself been

in the habit of looking at the evidence bearing on this matter for many years past, and my conviction is based on numerous facts derived from numerous sources. This conviction I have within the last half-hour verified, for I happen to be staying in the country with a gentleman who is well known and has had much experience respecting the interbreeding of cattle; and he has just, on inquiry, fully confirmed my belief that when, say of the different varieties of sheep, there is an interbreeding of those which are widely unlike, the result, especially in the second generation, is a bad one — there arise an incalculable mixture of traits, and what may be called a chaotic constitution. And the same thing happens among human beings—the Eurasians in India, the half-breeds in America show this. The physiological basis of this experience appears to be that any one variety of creature in course of many generations acquires a certain constitutional adaptation to its particular form of life, and every other variety similarly acquires its own special adaptation. The consequence is that, if you mix the constitution of two widely divergent varieties which have severally become adapted to widely divergent modes of life, you get a constitution which is adapted to the mode of life of neither—a constitution which will not work properly, because it is not fitted for any set of conditions whatever. By all means, therefore, peremptorily interdict marriages of Japanese with foreigners."

Despite the supposed philological evidence, which is highly dubious, probably no one who has handled a few European and Japanese skulls would question that the common origin of the two is well-nigh as remote as the common origin of any two human races can be. And if we care to accredit biological truth, we are face to face with a grave problem in considering the future of the Japanese.

Assume that brains beat brawn in the present war; or assume that reaction delays a little longer the course of human evolution; at any rate, some day the Japanese will get a footing on the mainland of Asia, which their ancestors left so long ago. No fears of "race-suicide" need worry Japan. Her teeming peoples will one day encounter, not as now in battle array, but in peaceful intercourse, the races of Aryan origin. If we are to believe a tithe of what we hear, the Aryan is not insusceptible to Japanese charms. No one who looks far enough ahead can doubt that Aryan and Mongol will fuse some day. But we hope that, for the sooner solving "the riddle of the painful earth," that commingling may be *a slow and gradual process.* East need not be always East, nor West always West; but woe to those who forget the lesson of the poet's assertion as to the present: East *is* East and West *is* West. For if we translate Mr. Kipling's line into biological language we find it to be neither more nor less than a summary of what Spencer pointed out in the passage I have quoted. At present the peoples evolved under an Eastern environment are widely different from those evolved under a Western environment. Therefore to mingle Eastern and Western races *at present* is to court disaster: so biology assures us. But we may look forward to a time when the varying environments of the advancing races, all the world over, will be much more assimilated than they are at present. Hence these different races will also be more assimilated, and *then* the process of fusion may safely take place.

But before we proceed to speculate as to this possible, and, as we may perhaps come to see, desirable fusion, we must obviously try to discount, if we legitimately can, the current talk about the "yellow peril." Is it really a peril—or a promise?

This question is well worthy of discussion, and highly in need of consideration in a somewhat more reasoned manner than that to which we are accustomed. For if, indeed, there be a yellow peril, then it is a peril indeed—to us, if not to the future of humanity; while if there be not, there must certainly be alternatives well worthy of the gravest thought.

The present talk of the yellow peril, while unconsciously dealing with an essentially scientific subject, has all the characters that distinguish the ideas of any untrained mind. Most notably of all, it starts with an unproved assumption which, if disposed of, leaves it without any trace of a foundation in facts. The assumption, of course, is that a racial war—I use the word war in the usual sense of a *military* war— is the inevitable result of a racial awakening such as we anticipate for the Mongolian. But before any one expects to be seriously regarded in this matter, before he has any right whatever to further hearing, he must first either demonstrate or give reasonable grounds for the probability that racial war *is* the inevitable consequence of the modernisation of the Mongol. And, to accomplish this, he obviously must consider all the possible alternatives, and give reasons for regarding them as less likely than that against which he would warn us. Now at least three possibilities are patent to the meanest mind. (It is not a high order of intellect, but merely a logical and scientific method of approaching the question that is here needed.) Thus the white race may exterminate—or subjugate—the yellow as the consequence of a racial war, or the yellow may exterminate—or subjugate—the white, *or* the two may fuse without war. Before we indulge in wild speculation about the yellow peril we must dispose of the first and third of these possibilities—not to mention others, such as the likelihood that each race has its appointed term, and that, without any yellow invasion, the white race may come, by inevitable law, to a natural end produced by internal causes. Surely this way of approaching the subject is no more nor less than reasonable, while the conclusions to which some protagonists of Russia are at present rushing have precisely the worth that attaches to all conclusions based upon unproved assumptions.

Now, as to the first possibility—that the white race will exterminate, or subjugate, the yellow—there is at least one most significant fact which is at all times and in almost all connections worth remembering. It is that the birth-rate in nearly all "civilised" countries—that is to say, the birth-rate among white races—has been falling for many years past, and is steadily, generally, and perhaps inevitably falling to-day. Sorry indeed should I be finally to attempt the task of explaining this phenomenon; but I certainly believe that it is not a symptom of an inevitable race-decadence, but that it is, on the contrary, a preventable and largely voluntary, if not a normal, consequence of our present mode of civilised life. There is absolutely no evidence whatever in favor of the view that a similar phenomenon is to be observed in China and Japan. There is, on the contrary, every reason to believe that the yellow race is increasing, at the present time, more rapidly than the white. Numbers, of course, are not everything; but at this stage in far Eastern events there is no need to observe that the brains are not wanting to the race which might have received the promise to Abraham. It multiplies as the "sands of the sea," but these yellow sands run to brains as well as grit. Wherefore I believe that the white race has small promise of exterminating—or subjugating—the yellow.

The argument at present, therefore, is in favor of the yellow peril, and would perhaps be welcomed as conclusive by any one to whom the third alternative had not presented itself. But we must not forget it. Perhaps we may hazard the guess that European civilisation will make less prolific the race that adopts it, just as it has lessened the fecundity of the race which credits itself—I understand—with having invented it. (We may remember that our civilisation was born in western Asia, and not in

Greece, as the Hellenists would no doubt have us believe.) Let us grant, then, that the rate of increase of white and of yellow may ultimately become very similar. What is to happen? Well, if you believe—and there is really no reason to do so—that the white race is already nearing the term of its career, nothing better could happen for the world than that, by an infusion of new blood, it should be rejuvenated, or, at any rate, that the best elements of its life should be represented in a new world race. But if you do not believe that the white race is already thus dying of old age, and if you recognise, as you must, that war plays, as the centuries pass, an ever lessening part in the world drama, and that it is in the highest degree improbable that white and yellow should regard such an appalling criterion as desirable or even conceivable, then you are left with the alternative of peaceful fusion. Already this process has begun—prematurely, no doubt — in the treaty ports of Japan, and in Tokio. If you believe that each race would prefer war to fusion you deny the lesson of the past, that race-hatred, strong as it still is, yet is characteristic of a primitive stage and of primitive peoples. It has played a great part—like war, its offspring—but science has pronounced its doom. Science has given us means of communication which are daily and rapidly reducing the size of the planet on which we live. Race-hatred, the product of ignorance, misunderstanding, lack of appreciation of one another's past, and utter absence of the conceptions that science has given us, is a thing doomed—thank Heaven—to die. Science looks for the day—of its own bringing—when humanity shall have a single consciousness and a united front in the last war—in which union will indeed be strength, as disunion in the past has been impotence—the war which man will wage, with a success of which the history of his evolution from the dust is a guarantee, against the evils within and the evils without—or, in other words, against that which must be conquered in the heredity and environment that have produced him.

We are, perhaps, too apt to imagine that nothing better than the white race is conceivable. But as regards colour, at any rate, there is surely no inherent superiority in one rather than another. At present the white man no doubt considers the yellow man discoloured, but the yellow man thinks the white man pallid and colourless. Is it not possible, or indeed probable, that the world race of the future may be neither white nor yellow, but golden? With the coming of that great idea which we call evolution, must we not realise that there is no finality in these matters? And while colour is but a superficial character, may we not believe that the law of the survival of the fittest may effect in the coming race the combination and enhancement of worthy characters already impressed upon both white and yellow, while unworthy characters, still only too obvious in both, may be more or less completely expunged? At any rate, we may hope so.

JAPAN AND CHRISTIANITY

Probably no subject can claim greater interest for the student of contemporary sociology than the relation of Japan to the dominant religion of the civilised world. In a recent interview, the Rev. Dr. Pentecost declared that, in his opinion, Japan must necessarily take over Christianity, having taken over its product—Western civilisation. The idea of modern battle-ships as a product of Christianity is not particularly beautiful, and I fancy most of us would agree with Newman's position, that modern civilisation is anything but a product of Christianity. But, leaving the reverend doctor, we may address ourselves to this most fascinating question, the answer to which cannot fail to be of the gravest significance—will Japan ultimately become Christian?

First let us get what guidance we can from history. Christianity first reached Japan on August 15, 1549, when the noble missionary, St. Francis Xavier, landed at Kagoshima. He remained in Japan for two and a half years. The number of converts claimed for the Jesuit missions of this time is six hundred thousand, according to Professor Lafcadio Hearn. Professor Foxwell, in his recent lectures at the Royal Institution, put the figures at one million. The difference does not matter, however, for all authorities, according to Professor Foxwell, are now agreed that the conversions were mainly nominal, bringing with them, as they did, the acquisition of novel and efficient weapons from the Portuguese. Hence Christianity became a source of danger to the ruling powers, to whom these well-armed converts offered no allegiance. At the beginning of the seventeenth century—in the year 1603, to be precise—the country of Japan was closed. Systematic war was declared against Christianity. Many native converts were tortured and martyred. The alien creed was utterly stamped out. No European was allowed to enter Japan; no Japanese were allowed to leave it. Any Japanese returning from abroad were put to death. At that time Japan was in a state of material and moral advancement fairly comparable with that of our own islands: but for two centuries and a half, during which the country and all its inhabitants were absolutely marooned, it was given over entirely to the soporific influence of Buddhism, there being nothing whatever to narrate of the history of Christianity in Japan throughout that long period.

A little less than half a century ago the country was opened, and the history of Christianity in Japan begins a new chapter. And first as to its official history. Some years ago, when the Mikado and his government were engaged in the reconstruction of Japanese society, they considered the question of Christianity. A commission was appointed to prepare a report upon its influence in checking vice and crime abroad. The verdict was unfavourable, and was in consonance with that of Kaempffer in the seventeenth century, who said of the Japanese, "They profess a great respect and veneration for their gods, and worship them in various ways. And I think I may affirm that, in the practice of virtue, in purity of life, and outward devotion, they far outdo the Christians." The commission seems to have been appointed in recognition of the principle, "By their fruits ye shall know them." One wonders whether the horrible irony of the situation has appealed to the officials of Christianity.

The Japanese government, therefore, did not adopt Christianity. During their struggle for treaty revision—which culminated in success only five years ago—they would have been much aided by even a hint to the effect that Christianity would shortly receive official recognition. Nevertheless, not only did they avoid any such hint, but rather suggested the reverse, even when the negotiations were most critical; and Professor Foxwell gives them great credit for their high sense of honour in this matter.

So much for the history of Christianity in its relation to the Japanese government. Now let us consider its history in relation to the people. According to Mr. Hearn, there were in 1894 some eight hundred Protestant, ninety-two Roman Catholic, and three Greek Catholic missionaries. They claimed to have at that time about one hundred thousand converts between them, the Roman Catholics having much the greater success in proportion to their numbers. Mr. Hearn considers that Christianity has no chance of success in Japan. Every one who knows his remarkable and profound writings is aware that more weight must attach to his opinion than to that of any other man at present living. Mr. W. G. Aston, in his *History of Japanese Literature*, published in 1899, states the number of native Christians at one hundred and thirteen thousand. He differs from Mr. Hearn, considering it "simply inconceivable" that Christianity should not follow European philosophy and science, which the Japanese have already accepted. He considers that, as was the case with Buddhism, there will be some modification, probably in the direction "of a more rationalistic form of Christian belief than that which prevails in Europe." If European science and philosophy depend upon Christianity, then certainly Mr. Aston's conclusion is irresistible.

We are told by contemporary authorities that the attitude of educated Japanese at the present day is one of agnosticism. Elsewhere in his writings Mr. Hearn quotes certain criticisms of Christian dogma as representing the present attitude of the upper classes in Japan. It appears that a great many Christian beliefs are regarded as of Buddhist origin, including the belief in the Virgin Birth. This is easily explicable, since the Buddha, like his analogues in the Egyptian and other religions, was believed to be born of a virgin.

It would surely be very foolish for any one not intimately acquainted at first-hand with the psychology of the Japanese to base any prophecy upon the scanty objective data at our disposal. All I would maintain is that any one who wants a serious issue to think about will find one here. Obviously it would be necessary to consider the present religious beliefs of Japan in coming even to a provisional conclusion. Knowledge in this matter seems to be scarce, if one may judge by Count Tolstoï's recent assertion that the people of Japan are fighting against the dictates of their religion. This is obviously true, as he asserts, of his own people; but the duty of obeying the Mikado is part of the fundamental tenet of Shintoism, the primitive religion of Japan. The present essay does not pretend to be anything more than a mere sketch. The writer's excuse for presenting it is the magnitude and pregnancy of the subject. Time will tell, it may be objected, nor need we do more than await the event. Nevertheless, the relations between Christianity and this astounding people are of much more than local interest. If we remember what Japan has proved herself to be at the present day—a humane and honourable foe, for instance—we must acknowledge the question to be one of planetary significance. Christianity, which arose in Asia, has never yet obtained a hold over any Asiatic people; doubtless because, in the first place, the Roman Empire was essentially European. Now that a new order of things is upon us, science having already potentially unified the earth, it seems evident that the future of Christianity among the leading Asiatic people is a question which makes an almost unique appeal to every thinking mind.

SOME URGENT POINTS IN PÆDAGOGY

EDUCATION is a very much more significant word, etymologically, than pædagogy, and a very much less ugly one. I use the Greek term merely because it makes unequivocal reference to the child, and because it is the education of the child to which I wish here to refer. It is, indeed, a scandalous thing that one should have to insist again upon the fact that true education is not a matter concerned merely with the child or the adolescent. The perfectly educated man never was nor will be, and it is especially necessary, in these utilitarian days, to insist that there is a higher utilitarianism than that which aims at making a child "a more valuable national asset" by what we are pleased to call education. For contemptibility—unless one regards the swelling of the national exchequer as a means to a higher end—this is on a par with the idea implicit in the term "finishing school"—as if any educative process could be final. What incredible presumption such an idea implies, if we look at it twice.

Confining ourselves to the popular meaning, education, properly speaking, is the provision of a fit environment for the young and foolish by the elderly and wise, and its supreme end is character-making, which is itself the only means by which the ethical ideal may ever be attained. These are commonplaces; but, after all, as Stevenson has said, the commonplaces are often the great poetic truths: which is my excuse for stating them. But in this article I can attempt only to insist on one or two principles of the first importance in this youthful but high-destined science of education, which is based upon and is part of all other kinds of knowledge. As we shall see, the educationist must, in theory, be familiar with embryology, physiology, psychology, hygiene, and practical medicine, not to mention the various morbid conditions that may affect the growing mind. Yet, if you are fit for nothing else, you may, at any rate, start a private school!

And, unquestionably, the first thing to insist upon in these days is that the education—in the narrow sense—of a child must not be begun too early. Any one who desires to read a clear and popular discussion of this subject should study a paper by the distinguished Edinburgh alienist, Dr. Clouston, in a recent number of the *Paidologist*, the journal of the British Child-Study Association. Dr. Clouston reminds the reader that the actual construction of a child's brain is not completed until the seventh year, and he insists, as so many of his profession, judging by experience, and

Spencer, by *a priori* reasoning, have been insisting for many years, that the mental education of our children is, as a rule, begun too soon. You may retort with the celebrated case of John Stuart Mill, whose father began to teach him Greek when he was only three. Yet we may guess that the nervous facial twitching to which Mill was subject in later life was a consequence of this premature strain. We must look at this matter in the light of evolution. Before man had any mind worth mentioning he had a body. It is the same with every son of man to-day. The first education of a child is, therefore, to be physical, a training of the senses and of the power to use the muscles. Hence the natural instinct of the baby—or the kitten—for *play*, which is to them the very best possible *work*. Playing with a moving object, the child or kitten is training the muscles—altogether twenty in number—that control its eyeballs, and is training that part of its brain which appreciates visual images. Further, it is learning to adjust the movements of its body to the impressions received by its senses—as in catching a ball. This training is invaluable and primal, because it is a training in the means whereby we avoid danger—as in dodging a hansom in later life—and must be perfected first, because, as Spencer has actually had to insist, we must *preserve* our lives before we are able to *use* them.

With the law of development still as our guide, we must further realise that the moral sense is the last to be evolved. It is in the highest degree ridiculous to give a child a training in ethics before the latent powers of its muscles and its inquiring mind are exercised. And one word on that spirit of curiosity, of wanting to know why. The German philosopher, Lichtenberg, has called man the "restless, cause-seeking animal": this is the divine thirst for knowledge which makes us the lords of creation. The parent—I say the parent and not the school-master, because I still labour under the Old-World and wellnigh obsolete conception that the parent is the child's natural and proper teacher—the parent, then, who attempts to stifle the spirit of inquiry in a child's mind is stifling the mind itself, and thereby incurring an awful responsibility. Would I could make my words stronger.

And this suggests the opposite case. The fond parent of a precocious child—and notably the fond mother of a precocious man-child—may fall into the error of fostering its precocity. Let her beware. The precocious child that becomes a prodigy stands to reach a premature end. In the majority of cases—there are many exceptions, I know—the infant phenomenon not only does not retain its mind in advanced years, but never reaches them. The recent scientific study of the child has shown most finally that precocity is to be discouraged rather than encouraged. The child that loves its lessons must be taught cricket forthwith. The mind is there right enough; the cricket will not destroy it. Give it time and it will make fresh conquests for humanity. Give the child open air, direct its mental activities to pursuits which do not depend on the printed page—men thought long before they learned to read—and one day your child will rise up and call you blessed.

To this there is, in part, an exception, and that is the musical child. It is perfectly congruous with the fact that music is the most creative of the arts (which depends less than any other on environment and more than any other on heredity), that musical talent should naturally show itself at an earlier age than any other. Biography teaches us that the musical prodigy very frequently *does* survive, and that the early development of musical powers is to be regarded as almost, if not entirely, normal for the particular individual in question. In reading the lives of great composers and executants one is repeatedly struck by this fact.

And another point. We "humans" are mentally distinguished for our power of attention and concentration. The trained mind will approach a matter and stick to it, not losing the thread at the first difficulty. If it starts to read a serious article and meets an unintelligible phrase it will not resort to the waste-paper basket. But this remarkable and almost inexplicable power of attention or apperception is slowly gained. The child's power of attention is notoriously small. We must not expect too much from it. I seriously question whether half an hour should not be an outside limit for the length of a lesson up to the age of ten years at least. A child who attends for so long to a task which is quite as difficult to it as your tasks are to you—assuming that you ever attempt to master anything new—has done very well. A headache at the end of a lesson means that the child has lost when it should have profited. In some countries, which have gained more than we have by the work of English educationists—Spencer's epoch-making little book is put into the hands of every state-teacher in France—the type in which lesson-books are printed is made a matter of the utmost importance, and countless headaches are thereby averted. This one point really needs an article to itself.

Another gross error in our present system is that of too early specialisation. Just as the child, which only late acquires a sense of right and wrong, is initiated into the mysteries and anomalies of its parents' private ethical code long before its time, so, a few years later, it is instructed in the three R's long before it is taught to observe—or, for that matter, to brush its poor little teeth, probably already ruined—to the lasting detriment of the appearance of the lower half of its face—because the parents, in their turn, were taught next to nothing about elementary hygiene. So, after a few more years, this premature specialisation is, for the third time, thrust upon it, and the ridiculous nonsense known as English grammar—a dry-as-dust, worthless imitation of the syntax of Latin, a language which really had a grammar—is forced into the child's uncomprehending ear, only to leave its head forthwith by the other. Similarly Latin and Greek are both begun too soon, as our wisest are beginning to show us.

The purpose of this essay will have been served if the consideration of these few points causes the reader to refer to Spencer's work, *Education: Intellectual, Moral, and Physical*, which was published in 1861. The date reminds me of a remark made by a librarian at the British Museum, that everything is written over again every forty years. The new brooms in the Education Department of Great Britain have recently issued a series of recommendations—described by the press as "epoch-making," "revolutionary," and so forth—which are all commonplaces to those who know this book. As Professor Michael Sadler has remarked, it has already, though unknown to our rulers, abolished the false ideals of his day in the education of girls, has begun to effect a recognition of the value of physical education, and has, I may add, relieved the burdens and increased the happiness and health and future usefulness of thousands of children's lives. No wonder that it has been translated into some fifteen languages, and that its author has been hailed as "the great educational reformer of the nineteenth century." Like so much else of his work, it has permeated the thought of the time so completely that some of his critics—not knowing their advantage in living after instead of before him—have called it platitudinous.

But you will not find these platitudes in any previous writer, great as have been the men who have devoted all their thought to this momentous subject. One little instance. It needed Spencer to teach the medical profession that children like sweets, not because of original sin, but because sugar is an invaluable food to the growing organism. He argued *a priori;* and now science has applied the *a posteriori* method to the same question, and has proved him right. The formulæ of two typical sugars—$C_6H_{12}O_6$ and $C_{12}H_{22}O_{11}$—will show this to any reader acquainted with elementary physiology. The fact that the human alimentary canal contains several special arrangements for digesting sugar serves to support this view. The experience of the German army and the Arctic explorers has confirmed it, and now every one admits that sugar is an invaluable food to the growing, as to the adult, organism. More than half the total energy of the body is actually produced by the oxidation of sugar—into which starch is transformed by digestion.

Beware, then, how you repress the healthy instincts which millions of years of heredity have produced in the coming race—instincts which we now admit it would be blasphemous to call sinful. Such are a love of sweets and a love of knowing "why."

CAUSATION AND GENIUS

More fundamental than the belief in the unity of the Cosmos or in the conservation of energy is the scientific avowal that *causation is universal.* In other words, the first article of faith in the creed of science is the "law of continuity." We believe that throughout eternity there is eternal causation, immitigable consequence: that nothing is uncaused or "self-caused"; that there are no breaks; that *natura non facit saltum;* that there is neither chance, caprice, nor contradiction in the Cosmos. We believe this though it is obviously incapable of proof in the strict sense, and we are daily including within causation that which has formerly boasted of its independence. It is only because meteorology is backward that the prayer-book still contains a petition for fine weather. When we know a little more about atmospheric electricity, solar prominences, and the like, that petition will have to be deleted for very shame. Similarly with more recondite matters: "free will" once defied us. Nowadays it can easily be proved to be a "pseudo-idea," not really even thinkable. Whenever we investigate apparently arbitrary phenomena with sufficient closeness, we find that law and order pervade them. As Sir William Huggins said recently at the annual meeting of the Royal Society, "In truth law, not chance, governs all." The evidence for this belief is strengthened with the daily increase of knowledge, and is drawn from the realm of the living as well as from that of the inorganic world. We cannot now conceive of uncaused or self-caused phenomena. An Adams or a Le Verrier observes the perturbations in the movement of a planet; he is quite certain that there must be a cause for them. Applying the law of gravitation—to which he can conceive of no exception—he finds the cause. Thus Neptune was discovered by the aberrations in the path of Uranus. The physician knew that, at a regularly recurring stage in a case of malaria, the patient's temperature rose. For this, as for the eccentricities of a planetary orbit, there must be a cause. Now he knows that the rise of temperature is due to the discharge of a new generation of parasites from the red corpuscles into the fluid of the blood. Or we have an habitual criminal. Given every opportunity for reformation, he reverts to his bad practices. You may call this original sin if you please, but it has its cause in heredity and environment, the action of which can now be traced with comparative accuracy and certainty.

But this universe, governed by irrefragable laws admitting of no exception—a universe, that is to say, in which orderly causation is universal—is worthy of the name, for it is essentially a single whole. We see diversity and complexity all around us—ourselves their foremost illustration—yet the verdict of modern science coincides with the speculation of ancient philosophy in declaring the universe to be essentially one—a monism, if you please. In it there is no fact inconsistent with any other fact, nor any minutest change that has not its consequences for the whole. For the universe is all-of-a-piece. Between the atoms which these words have thrown into motion in your retina and the atoms of the farthest star there is a mutual attraction which can be measured to the utmost fraction when their mass and distances are known. The poet is literally justified: you cannot stir a flower without deflecting the course of all the stars. The law of gravitation declares that you cannot alter the position in space of one atom without altering the position of every other atom in the Cosmos.

It is, then, no idle boast or baseless speculation that the universe has been reduced to a monism. There is, indeed, no other unity, for whatever is, is part of this stupendous whole. Your fancied isolation and mine is, in this sense, a delusion. The antithesis between the ego and the non-ego is, on this theory, but a convenient manner of thinking; for, like Tennyson's "Ulysses," you are a part of all that you have met—and, indeed, of all that you have not met.

This universe, then, of which we conceive as a unity whose supreme law is the law of continuity—continuity absolutely unbroken since any beginning you care to conceive—has another essential character: it is indestructible. The sum of things is now precisely what it was a billion æons ago, and precisely, to the fraction of an atom, what it will be a billion æons hence; neither more nor less, for matter and energy—of which alone, for the present argument, we conceive the universe to exist—are eternal and uncreatable. Were all the forces of the Cosmos ranged to destroy a single atom or to create a new one out of nothing, they would be utterly impotent. Our conception, then, is that of an indestructible unity ever undergoing, as Spencer has taught us, the balanced processes of evolution and dissolution, but ever essentially the same, one and indivisible, and swayed by ever-present and omnipresent causation.

With this view of the Cosmos, now held as generally as any view, however well-founded, can hope to be, let us see how, if at all, our common modes of thinking are affected. Walking along the road you meet a tramp. His sunken nose indicates the presence of a loathsome disease. His blear eyes and flabby lips suggest the direction in which your alms—solicited in a husky voice that tells the same tale—will almost certainly go. The colour of his skin has been developed by years of dirty habits. The creature has an expression hardly human, infinitely less pleasing than that of his mongrel dog. You offer him work, and find that he has little taste for it. You realise that he manages to find sufficient food and drink and shelter, though he does no work for them. Host of numberless parasites, he is himself a worthless parasite upon society, contributing nought to the general welfare, consuming food, breathing air, occupying space that might otherwise have supported an honest man. His lot is entirely "of his own choosing," and deserves no one's commiseration. Repellent alike to your eye, your ear, your nose, and your sense of touch; to your social sense; to your "public health conscience," for he is the unvaccinated vehicle that conveys small-pox from town to town; to your sense of human dignity, and to I know not how many more—what possible feeling but loathing and contempt can he inspire in you? But what about this conception of the universe as a continuous unity, of which no fact is inconsistent with any others, and in which everything is in turn effect and cause in an endless chain of causation? It seems to me that the deduction from science is the same as that from the spirit of the Christian religion. For on our theory this loathsome object, parasites, odor, and all, is an expression of the cosmic forces, just as much as yourself. He has his chain of causation behind him, and is as valid and inevitable a manifestation of the Cosmos as Sirius or the Pleiades. He shares with you and them the honour of forming part of the cosmic monism.

Latterly the universe has become self-conscious in the mind of man, and has acquired the awful power of influencing its own destinies. Hence the tramp, though inevitable as a product of the past, is not necessarily to be produced in the future. And we shall the sooner abolish him when each of us is come to the all-embracing conclusion, as charitable as it is philosophical, that causation is universal. Conceive of the next tramp you meet as part of the universe and one of the necessary products of its past.

But though this conception of universal causation seems to the scientific mind an absolutely inevitable and perfectly natural one, to which everything points, we need not pretend that there are no difficulties in the acceptance of it. Firmly as the philosophic scientist believes in the law of continuity, he recognises certain facts which have not yet been fully reconciled with it. Such facts will occur to every reader, but let us look at some of them.

Many people still believe—and the greatest of living scientists is of their number—that the origin of life necessitated a break in the law of continuity. But Lord Kelvin is not a biologist, and he cannot find leading biologists to support him. The distinction between living and not living has all but broken down. You cannot establish an absolute distinction. "Life is self-movement," said Thomas Aquinas; but radium was not known in his day. Then some confused thinkers have argued that the coming of *consciousness* cannot be explained by causation, not realising that all our knowledge, the concept of causation included, is confined to the contents of our own consciousness.

The present writer believes he has no choice but to accept the law of continuity, with all its tremendous implications. But, while doing so without any reservation, he finds his own private difficulty in something which appears to him to be far more inexplicable than the origin of life. As it seems to him, universal causation will have been established everywhere else ere it can ride cock-a-hoop over that sublime entity which we call *genius.* The assertion has, of course, been made. In his famous essays on the *Scientific Use of the Imagination,* Tyndall has the following passage:

> "Many who hold it [the theory of evolution] would probably assent to the position that, at the present moment, all our philosophy, all our poetry, all our science, and all our art—Plato, Shakespeare, Newton, and Raphael—are potential in the fires of the sun. We long to learn something of our origin. If the evolution hypothesis be correct, even this unsatisfied yearning must have come to us across the ages which separate the primeval mist [the solar nebula] from the consciousness of to-day."

And this is certainly the modern scientific belief. But before we consider the audacity—as many may call it—of this assertion about genius, we must cry a halt for a definition of it, if we can find a valid one.

Our excellent friends, the modern psychologists, who owe their existence to Spencer, but have "quite superseded him," tell us that genius is merely a possession in exceptional degree of the power of associating ideas; and they fancy that there is no more to say. Now, there is an obvious half-truth here. Intelligence, intellect of sorts, and certain types of genius may indeed be thus explained—mathematical genius, for example. If we attempt roughly to classify genius as *philosophical* (including scientific) and *æsthetic or creative*, then we may say that the first class of genius, *as long as it possess no tincture of the second*, offers no serious difficulty to the law of universal causation. We can explain it by the law of association of ideas, by comparison with mere talent, such as most of us possess a quantum of, and we find no serious difficulty. As a matter of fact — though narrow men will deny it—philosophic genius in its highest form is never met without some infusion of the *creative imagination*. The conception of universal gravitation, though it did correspond with objective truth, was a creative effort of Newton's mind. The Synthetic Philosophy, as even Dr. Fairbairn admits, could not have been conceived without the creative effort of a rare and noble imagination.

But it is in the purely creative or æsthetic genius that we see most clearly the strength of the last stronghold to bow to the law of continuity. And even here we may choose. The poet and the musician, as I see it, are more sheerly creative than their fellows. The law of association of ideas really throws no light that I can see on the C minor symphony. Of your Shakespeare or Beethoven I would say that they brought a new thing into the Cosmos, did I not know that without antiquity we could not have had Shakespeare, and without Bach we could not have had Beethoven. Causation we can trace in part, even in the case of these consummate artists. We can also study their parentage and environment, and say foolish things about this strain of blood giving this genius his insight and that his love of form; or this type of landscape giving him his "feeling for nature," and so forth. It is a curious fact that literary men, with an unconscious recognition of the law of continuity, are constantly attempting to give scientific explanations of the traits of genius, while scientific men themselves will shrug their shoulders and merely assent to the indisputable truth that a poet is born, not made. That is almost all we know about it. At some happy commingling of parental elements we can faintly guess, but that is practically all.

Now this is simply a reassertion of the popular belief. If we substitute the word musician for "poet," the truth is perhaps more indisputable than ever; or, better still, we may read "poet" in the literal sense of a "maker," or, to use the old Scottish word for a poet, a "makkar." You cannot explain a creative genius by education and environment. You must fall back on heredity. This is not to say that the parents of Shakespeare were like unto him. Though genius is often hereditary in the ordinary sense, as Mr. Francis

Galton has conclusively proved, it is oftener hereditary merely in the sense that it is congenital. The great service of sex, as we understand it, is to provide for numerous variations. The "commingling of parental elements" is preceded, we know, by a rejection of certain parts of the reproductive cells of each parent. The new cell, formed by the union of the parts not rejected, is therefore certain to develop into a person like, yet unlike, either parent. Now and again causes which we do not understand lead to the production of that extreme variation from the normal which we call genius. But though we cannot explain the process, we can locate it, thus definitely asserting that a genius is born, not made. Every man thinks that if he had practised as diligently, he could play billiards as well as John Roberts; but he is quite mistaken. And I believe I am right in saying that the musician illustrates this congenital nature of genius more clearly than any other. Little Franz von Vecsey, for instance, who, at ten years of age, can play Bach's "Chaconne" or Paganini's "Hexentanz" in a manner which hardly any mature violinist can surpass, is about as inexplicable as any phenomenon known to science. The theory of universal causation can do little more than stare at him; still less at an untaught Schubert, writing airs like "Who is Sylvia?" and "Hark, hark, the lark!" on the back of his menu-card in a beer-garden, within ten minutes of seeing the words for the first time.

Certainly if Carlyle were right in saying that genius is "the transcendent capacity for taking trouble, first of all," then *that* would indeed be no difficulty to the law of continuity; but it is obvious nonsense. Rather is genius, as Spencer observes, the capacity for doing, without trouble, that which ordinary endowment cannot do with any amount of trouble.

But somehow, content for the nonce with our utter failure to explain genius in terms of common causation, and remembering that mind and matter, as Spencer taught, are but different aspects of the unknowable, I am inclined to prefer, in a modern interpretation, another definition also of Carlyle's, which I have never seen quoted yet, and which seems to me to be one of the truest and most sublime things he ever said, that "genius is the clearer presence of God Most High in a man."

A CONTROVERTED QUESTION

THE great public, which is not ashamed—thank Heaven!—to give voice to its splendid sentiment of humanity, is told that vivisection is practised for the benefit of mankind. That this is its end, and that there already exists a great record of achievement, is not seriously to be questioned by those who have, after some labour, become possessed of facts in their study of this question. But here and there some may raise another issue. Very few of us see eye to eye with them, yet their claim to our respect cannot be gainsaid. They put their point somewhat in this manner: "Very well. We will take it that man has used his superior intelligence to wrest from the unknown certain facts of value to him at the expense of animals less cunning than he. He has advantageously used his power. But is it not a little hard on the weaker creatures which have thus served him and gained nothing for themselves?" And surely the ethical question thus raised demands an answer. ,One such answer might run thus: "We recognise that altruism, or sympathy for others, is the basis of society. We recognise that it has evolved and widened so that men of the highest type now include in their affections not merely their blood-relations, nor those in the same city, nor those in the same state, but all mankind. We recognise that some fine minds are concerned not merely with the happiness of living men, but that the 'hungry generations' which are to come have already won their thoughtful and unselfish consideration. Further, we admit that your position is rigidly logical and in strict accord with the truth of evolution, when you extend your sympathy beyond the limits of the human family, and include the dumb brute of to-day and of to-morrow within its benevolent grasp. But we maintain that sympathy with any conscious creature should be in proportion to its capacity for pleasure and pain. We therefore conclude that as man is sentient beyond all other creatures, that as man alone is a self-conscious self *who can foresee* pain and death, the vivisector's sacrifice of the lower animals to the service of man is entirely justified — even though the animals gain nought — on the 'greatest happiness' principle. The vivisector is the means of saving my child's life, and thereby adds more to the sum of planetary happiness than if he had saved the lives of, say, fifty puppies."

This is, perhaps, an irrefragable answer; yet, somehow, the plain fact that man is using his superior power for his own selfish ends, careless of the creature which is his instrument, has not been explained away thereby. But there remains another answer: that tens of thousands of animals themselves have already been saved from pain and disease as a direct result of the vivisector's work.

Let us take glanders as an instance. This very fatal disease of the horse and certain other animals is now known, thanks to vivisection, to be due to a bacterium called the *bacillus mallei*. From this a substance called mallein has been prepared, which is of the utmost value in diagnosis—to mention nothing else. This means that the infected animal is prevented from communicating his malady to others, which therefore benefit by vivisection. Glanders (also known as farcy or equinia) occasionally attacks man. The disease has been studied mainly in relation to the horse, and in experimenting with the bacillus three bacteriologists, including the Russian discoverer of mallein, have been accidentally infected and have died of the disease. This is the converse aspect of vivisection. Anthrax is even more noteworthy as an instance of the benefits derived by animals.. Our knowledge of it is all due to vivisection, Paste r proving by test inoculations that the *bacillus anthracis* caused the disease. (This was the first infectious disease the bacterial nature of which was proven.) Professor Roux said, in 1896: "Vaccination [of animals] against anthrax has now been put to the test of practice for fourteen years. Wherever it is adopted, there the losses from anthrax have become insignificant." These protective vaccinations in France have lowered the anthrax death-rate in sheep and cattle from about seven to one-half per cent. In other words, of every hundred sheep and cattle in France six are saved each year from this one disease alone as the result of the knowledge gained through vivisection. In *rouget*, a disease of swine, the results are similar. It seems almost a pity to speak of animal diseases in tropical regions, for our knowledge of them has only just begun to be acquired. The tsetse-fly disease; the malady of birds which resembles malaria, and vivisection experiments in connection with which gave us the key to the discovery of the mosquito as the infective agent of malaria—these and others might be adduced in proof of the present thesis, but the fruits of knowledge are not yet ripe in these cases. The argument is clinched by the mention of antiseptic surgery—a direct deduction from the facts of bacteriology, a science which would be non-existent to-day had it not been for vivisection. King Edward VII. would certainly not be on the throne at this hour but for this means of research. But what about animals? Simply this: that every animal on which a veterinary surgeon performs a successful operation to-day directly owes its life or its relief from suffering to vivisection experiments. Supposing that even a million animals—a ridiculous estimate[1]—had been sacrificed to establish antiseptic surgery, how many millions will by this method have been saved how many hours of pain ere the sun grows cold?

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[1] The actual number would probably not reach three figures.

But the need for insistence upon this often-forgotten result of vivisection is not my only excuse for raising this much-worn question in the present volume. It does not seem to be recognised that there is involved in this matter the whole theory of *scientific method.* Men of science maintain — and the whole history of science supports their contention—that the experimental method is the only one by which science can be advanced. Science is based upon accurate observation, and an experiment is simply a device for extending the range of observation and for affording us observations under definite and known conditions.

Of course, physiology must be advanced by the way of experiment, just as chemistry or physics must. One of the kindest and most gentle men that ever lived, Charles Darwin—who was not a physiologist—has left it on record: "What a pity it would be to stop all progress in such a grand science as physiology," by prohibiting experiment. This aspect of the question is beyond argument, but there is at first sight something to be said for those who declare that physiology should not be taught with the aid of experiments. Now we have it on the authority of every teacher in Great Britain —such as Schäfer of Edinburgh, who at present leads physiological research and education in that country; Gotch of Oxford, and Langley of Cambridge—that it is absolutely necessary to teach physiology in this way. Certainly not one in ten thousand students of the science would offer, from their converse point of view, a different opinion. In all other branches of natural science the same is the case. No one would question the need of teaching by experiment in plant physiology, for instance, where the entirely supposititious argument of a "brutalising influence" could not be entered.

It is not the present object to discuss the teaching of physiology alone, nor to advance any arguments in favour of this method as if it applied only to this science, transcendentally important though the bearings of physiology on psychology and public health, and therefore on the aim and end and crown of all the sciences, which is sociology, certainly are. But it seems necessary to discuss the reasons why the experimental method is as necessary in the *teaching* of natural science as in *advancing* it. And, first of all, there may be mentioned the entirely valid reason that the interest of the student—whether of chemistry or physics or physiology—is aroused by experiment as it can be in no other way. The teacher, therefore, obtains *attention*, of which Herbert Spencer has taught all teachers the theoretical and practical importance; and attention, concentration, or, in psychological language, apperception, is an essential requisite for the student's success. This simple argument, which no one who has ever attempted to study any natural science will for a moment question, should surely suffice by itself. But if it were necessary—as it certainly is not—to advance another, one is certainly to hand. It is, perhaps, a trifle too philosophical and profound for a court of law, but it is of the most far-reaching significance and simple enough in its essence. It is, in a word, that *there is no authority but truth*.

Times have indeed changed since William Gilbert and Francis Bacon led men into the right and only way of advance, by showing us that we must go "back to Nature" as our foundation. Glance for a moment at the history of philosophy and science before the dawn of our day, and you will learn why day did dawn and what constituted the darkness of the millennia that preceded it. If Aristotle—whose mental powers were compatible with the most careless and inaccurate observation—declared that one side of the body is hotter than the other, that there is an empty space at the back of every man's head, or even—incredible error—that men have more teeth than women, all the world accepted it. In the time of Galileo to doubt Aristotle was a blasphemy, and to show that he did not make a given assertion was finally to dispose of it. Modern science is what it is because it has changed all this; so that even at a popular Royal Institution lecture Lord Rayleigh or Sir James Dewar will apologise when he cannot experimentally demonstrate a fact asserted, and will say, "I fear I must ask you to take my word for it, to-day"—this from the greatest living authority on the point to an assembly of amateurs!

A recent biographer of Galileo tells us that he had from the first the habit "of examining an assertion to see what it was worth, instead of blindly accepting it on faith in the master or in deference to authority." Similarly, it is recorded that Sir James Simpson—to whom the world owes the use of chloroform—studded his college note-books with interrogation marks. A true deference to authority remains. If Lord Kelvin suggests an explanation for certain phenomena, all the world listens and remembers, until there comes further light; but if Lord Kelvin announces his discovery of certain experimental facts, no physicist rests until they have been confirmed or disproved. From even a Kelvin there is the appeal to Nature. In ultimate things no coruscation of authorities can make valid that which is not so. "The heaviest will reach the centre, . . . sinking; . . . it has its defluxions, its obstructions — nay, at times its resiliencies, its reboundings" (when authority mistakenly supports it), "whereupon some blockhead shall be heard jubilating, 'See, your heaviest ascends'; but at all moments it is moving centreward, fast as is convenient for it, sinking, sinking, and, by laws older than the world, . . . it has to arrive there." Carlyle was eloquently right. So it is that our modern philosophers have learned humility; and when Professor Schäfer tells a school-boy beginning physiology that faradic electricity stimulates a nerve, or when Lord Rayleigh assures the ladies in Albemarle Street that hydrogen and oxygen form water if they are combined, these masters of their subject account their talking worthless unless they can add, "Don't believe this because I say so, but —look: there you see it!"

To this assertion that the true teacher regards himself as but a demonstrator of Nature to his pupils, and that books—once regarded as the repositories of philosophy—are now recognised as embodying merely human, and therefore fallible, records of Nature, which is an ever-open and infallible document, there may be added a corollary. In these days, when many go to and fro, knowledge is not always thereby increased. If, let us say, a distinguished biologist publishes a book which attempts to prove that all the astronomers are wrong, beware of trusting in his authority. The scientist who writes a book wherein to prove to the public the truth of a new theory has already damaged his case. The acceptance of any such theory by those who are not in a position to confirm for themselves the facts upon which it is based can only retard the advance of truth. The book is a description, it says, of Nature. But Nature herself—the only impeccable authority—is still there. Why trust the book?

MARRIAGE, MULTIPLICATION, AND MORALS

Some months ago, in an obscure corner of his daily paper, the reader may have seen a brief reference to the commission recently appointed in Australia to consider some aspects of the vital statistics in the colony of New South Wales. After sitting for some months, the commissioners concluded that there are about one million fewer inhabitants of Australia than there should be, according to the ordinary laws of increase of population.

Mr. Coghlan, the government statistician of New South Wales, has recently written a short book discussing the decline in the birth-rate there. He finds a steady fall in the birth-rate; that the marriage age among women is nearly a year and a half later than it was in 1885, and that of every 1000 first-born children only 510 are, properly speaking, legitimate, 233 being legitimised by an urgent marriage, and 257 being illegitimate. In 259 out of every 1000 marriages there is grave cause why the marriage should take place—*i.e.*, in more than one out of every four marriages.

According to the press messages which have reached Great Britain, no sensation has been caused in Australia by the publication of Mr. Coghlan's book, or by the report of the commission. The facts were already known, and it is generally recognised that they apply to the whole of Australia.

This, then, we must conclude. Here is a great new country, which the white man has seized. The aboriginal has disappeared—we will not ask why. The yellow man is most rigorously excluded. And what is Anglo-Saxondom making of it? The population, tiny in proportion to the area, has ceased to increase. The acknowledged cause of this is the deliberate wish of the individual; in other words, the practice of what is erroneously termed Malthusianism (that most acute writer never having recommended this practice). As to marriage, the figures speak for themselves. If they stood alone they would be ghastly enough. But they do not stand alone.

Let us go to another new country where the Anglo-Saxon rules. Its President has lately been preaching about "race-suicide." Its birth-rate is falling; and we know why. America's reason is Australia's reason. The children are not wanted. As to marriage, only the other day one heard an account of an American woman who had been married ten times to three men—with the aid of the divorce-courts. Is it any better in Europe?

It is not. The birth-rate is falling in every European country, with the exception, I believe, of

Russia. The Russian peasant, poor chap, who is, I suppose, as fine a fellow as exists, apparently is still free from the canker which is unquestionably eating into the vitals of European civilisation. We may well wonder what will happen to him and his family—which at present averages over six children—when his accursed masters are at last overthrown.

I have attempted to introduce a subject which needs volumes for adequate treatment. I certainly have no dogmatic conclusions to present to the reader. I can simply leave him, assured that he will find, as I did, that this subject "gives furiously to think." Let us just review the facts. The most highly civilised country in the world has the lowest-known birth-rate; so grave has the problem become that many French statesmen—for occasionally in France statesmen fill places occupied in Britain by politicians—are devoting their lives to this problem. It is also to be remembered that France is not only the most civilised but the most irreligious of European countries. Here, in Britain, the problem is not yet so urgent. The men who lead us are not concerned about it, for the excellent reason that the thinkers of the nation have not yet pointed it out to them. Nevertheless, the facts must one day be faced.

The State, as we know, is on the verge of feeding the starved school-children—there are sixty thousand such in London—whom it already educates. From practically all parts of white civilisation the tale is the same. Marriage is tending to break down, parenthood is a nuisance, the State is becoming more paternal and the individual less so; and "Marriage is no longer the only occupation open to women," as some vulgar mind has it.

And, in the light of the disquieting news from America and Australia, reinforced by their own private wishes, people are asking whether monogamy is a natural state for man. As a student of biology, a friend of mine was asked this question last week—by a married man who was tired of his wife, but who professed a disinterested desire for scientific information. Now, despite certain recent writers, the answer most emphatically is that monogamy is the ideal towards which the whole evolution of animal life, since sex began, has been more or less steadily tending.

It is, of course, apparent that for the effecting of monogamy Nature should produce an approximately equal number of persons of both sexes, and, if she does so, we find an excellent argument for monogamy close to our hand. Now the remarkable facts are these. All the world over, as far as we know, Nature produces a very slight preponderance of male children. It is therefore very evident that polygamy, at any rate, is alien to her laws. Every living creature is assuredly meant to reproduce itself; the voluntary extinction of so many in our time being an *obviously morbid* phenomenon. And Nature never varies in the proportion she observes between the sexes. Fortunately, as one is bound to think, science is utterly unable to provide us with the means for interfering with this proportion—numerous attempts to do so having completely failed. We now know the attempt to be foreordained to fail, the sex of every ovum being fixed long before the individual in whose body it is contained has even reached her own maturity. Such is Nature's arrangement. It is true, of course, that in Great Britain, as in other countries, there are a number of "superfluous women"—approximately about one million. This is due to the fact that the death-rate among male infants and adolescents is higher—for reasons which certainly cannot be considered here—than among female infants. Hence, at the age of five or thereabouts, the numbers of the sexes become equalised, and thereafter woman leads. But this is as morbid a state of affairs as the great excess of women in early military societies, where the men are decimated by war. In such societies polygamy obviously becomes almost inevitable. But Nature has not destined man for either the military or the present industrial stage of society—though not one person in a million has ever contemplated anything better. For an admirable consideration of this great question of the balance between the sexes the reader should refer to his Buckle.

Another line of argument is derived from the fact that we see monogamy in the bird, which disputes with the mammal the honour of highest place in the animal world. Man has reached monogamy in a peculiar and, in a sense, a premature fashion. I honestly believe that, *as yet*, only one woman in three or four, and perhaps one-tenth as many men, are really evolved so far as to be fitted for monogamy—that is, for the *permanent* union, "till death do them part," of one woman and one man. But the leaders of man's moral evolution have realised the value of monogamy, and, *while their followers had the power*, they have insisted upon it. Hence an immeasurable debt which we owe to the Roman Catholic Church. But the world is now convinced that "they didn't know everything down in Judee," though, as a matter of fact, no moral truth has been discovered since the Crucifixion, or ever will be. The decay of authority, due largely to its abuse, and the disappearance of the old deterrents, such as excommunication, fear of hell, and so forth, have led, can we doubt, to the present chaos, and the white race will hardly survive to see order evolved again; unless, indeed, its birth-rate begins to rise. Will it so rise?

All of which has nothing to do with science, I may be told. Well, I will not set up my definition of science against that of my objectors; but this is the verdict of science, at any rate, that monogamy has an impregnable fortress in the laws of Nature, and that, after a period during which men tend to depart from it, owing to the disappearance of the belief that monogamy is a divine ordinance, divinely upheld and avenged, there will come a return to it, on the final grounds that, as Kepler said, the laws of Nature *are* the thoughts of God.

But this question of multiplication cannot be left without the consideration of a great biological principle which must be adduced as a corrective to any too hasty views which we may form on the question of the falling birth-rates of civilisation. In a certain type of book which a wise father places in the hands of his boys when they reach an awkward age, it is laid down as a cardinal fact in physiology that there is an antagonism between *reproduction* and *individuation.* Beyond a certain point the individual will suffer. This is the veritable cosmic root of the objection to vice. Whatever your objections to sensuality, and whatever their source, you will find that you can resolve them into this natural antagonism between *individuation* and *reproduction.* Scientific students of biography are aware of the very high proportion of men of individuality and genius who have left no children. Their works are these men's children. Had Herbert Spencer married, there would have been no Synthetic Philosophy: he tells us as much himself. On the other hand, we know how sensuality blights the life of the individual, and sensuality is simply the excessive indulgence of the normal and necessary reproductive instinct. In the human race this antagonism between individuation and reproduction is one of the most self-evident of facts. Now let us look at the earlier stages of life.

The protozoa, as every one knows, are, properly speaking, immortal. They divide and re-divide without end. In their case the individual hardly exists at all, for the individual is itself the reproductive cell. That is to say, in them there is only reproduction; no individuation being yet seen.

But with the many-celled animals (and not with sin) "came death into the world." In them—from the lowest to the highest—certain cells are set apart for reproduction; and these, being really the race, are immortal. The individual, indeed, is to be regarded, in the lower forms of life, both animal and vegetable, as little more than a temporary host for them and, having duly handed them on—having thus fulfilled its destiny—the individual disappears.

But the higher we go, the more important the individual becomes, while the reproductive function is subordinated. The reader can easily fill in the details for himself, and will arrive at the logical conclusion that, in the highest individuals, reproduction will be an extremely different affair from the prodigal fecundity of the bacillus, or the fish, so that we reach the stage of "one at a birth"—at which stage humanity, in about eighty-seven cases out of eighty-eight, has already arrived. Furthermore, the number of births will tend to fall, on this theory; and so it does. *In part*, therefore, the fall in the birth-rate among the higher races is to be regarded as a normal phenomenon, in consonance with this great law. And we can imagine a further stage. Starting with the race which is all race and not individual at all, we may end with the individual which is all individual—the race thus coming to an end. This disastrous sequel is what we already see in many quarters, where individuals are deliberately, in their own persons, putting an end to the process—millions of years in duration—which has produced them.

If we look further into this principle we may deduce certain conclusions as to human population in the future. We find that the high degree of fertility in the past, causing a pressure of population, has made possible that process of selection of the fittest which leads to the evolution of higher types of mankind from lower. We find that pressure of population, entailing incessant competition, makes necessary the expenditure of so much thought and energy on the business of life, thus leading to growth of mental power. Only necessity could make the great majority of men submit to the discipline of incessant application; and only this discipline could produce a further progress. Excess of fertility is thus the cause of man's further evolution, while this higher development of the individual causes a decline in his fertility. "The future progress of civilisation will be accompanied by an enhanced cost of individuation, . . . which implies a diminished reserve of materials for race-maintenance." Hence we arrive at a form of life in which its amount and fulness for the individual will be the greatest possible, and the births and deaths the fewest possible. The atrocious infantile mortality of the present day—destroying one life in six or seven before the first birthday is reached, and allowing less than half of all human lives to reach maturity—will ultimately cease. This tremendous economy in the number of deaths, and, therefore, of futile births (*i. e.*, of wasted reproductive energy), will mean the availableness of so much more energy for the completeness and perfection of the individual life. I have done my best to keep King Charles's head out of this article, but I am bound to refer the reader to the place wherein this fundamental principle of the antagonism between individuation and genesis is first set forth. Biologists had existed for more than two thousand years, with the facts before them, but none of them had seen it. The first and final statement of this law, including certain predictions now fulfilled, is to be found at the conclusion of the *Principles of Biology*, in the chapter entitled "The Laws of Multiplication." Its discovery would alone have sufficed to give its incomparable revealer a permanent place in the history of knowledge.

THE COMING OF LOVE

TRACING beyond antiquity the history of our kind and its ancestors, can we discern the origin of altruism or love in the distant past, and trace its development during successive ages? Or are we to accept the moral sense of man to-day as a species of intuition, a thing recently and directly stamped upon his mind? The whole body of modern thought revolts at such a supposition. The tree of the knowledge of good and evil, which stood in the middle of the Babylonian Garden of Eden, must have had its roots, we are assured, in geological strata that are far more than six thousand or six million years old. We cannot begin with yesterday, for, as Emerson has it, "Man is explicable by nothing less than all his history."

If we observe that never-ending wonder and delight, that tell-tale historian, that living epitome of the past—the growing child—we can discern in him certain of the stages and features of moral evolution, chronologically considered. The moral sense must evolve within him, as it has been evolved in the race; and, in his younger years, we need not expect much altruism from him, any more than from his more distant ancestors. In a typical case we find that what is really the reproductive instinct is needed to awaken in him the highest measure of altruism: not until he "falls in love" is he actually willing to die for another. We surely need not hesitate to recognise that this is the reproductive instinct. What says Emerson, to quote from another essay: "The lover seeks in marriage his private felicity and perfection, with no prospective end; and Nature hides in his happiness her own end—namely, progeny, or the perpetuity of the race." Thus in the history of the individual we may observe this most intimate association of altruism and the business of reproduction. Now let us look at the history of the race.

Logically, we must recognise, as Spencer does, the rudimentary germ of altruism in the first division of the first living cell, but the beginnings are verily feeble enough as seen here. At any rate, we may observe the association of what must fairly be termed something more than egoism with the function of reproduction, which is Nature's most decisive demand from any living thing. When we go a little further we shall find ourselves entitled to the conclusion which has already been hinted at, that love is inextricably bound up, in its origin and development, with this prime function of living matter: a conclusion worthy of contemplation, since it shows us how intimately entwined are the roots of the moral sense with the very first principle of living matter.

But before we reach anything that can definitely be recognised as altruistic, we must pass onward for many thousands or millions of years, until we observe the evolution of a new phenomenon—which we call sex. In accordance with the principle already observed, we find that this striking modification in the business of reproduction is associated with a very great development in altruism; for even sexual love is partly altruistic, and has doubtless had its value in developing charity among men. And we find that the burden of the reproductive—or altruistic—act falls upon a particular sex which we call female. We find, furthermore, the evolution of an object called an egg, and we discover that the parents, especially the female, develop certain sentiments of affection towards this egg: sacrifice egoistic desires, in order that they may keep the egg warm; seek for food with which to feed the young creature hatched from the egg. The birds have gone no further than this. Beautiful and significant as is their parental care—except in certain polyandrous degenerates such as the cuckoo—the egg and all it implies constitute the limit of their altruism.

But there is evolved a new and strange phenomenon. It is called a mammal, and its coming is the greatest event but one in the history of life. The oldest mammals on the earth are found in Australia. The zoologist calls them the monotremes, and their type is the duck-mole, or ornithorhynchus. These strange creatures are mammals, for they suckle their young; yet they lay eggs. Their survival on a sequestered island serves to-day to show us the gradual development of the mammal from the egg-laying or oviparous animal. Then there is reached another stage. The young creature is born "alive" —as if an egg were not alive!—but unable to live unless it be partially restored to its mother. The marsupials represent this stage. The young kangaroo, born after it has passed through the egg stage from which we have all emerged, but born prematurely as compared with the higher mammals, is restored to the maternal pouch, there to complete the first stage of its development.

And then we reach the typical mammal, such as the cat. And we may observe that, all this time, the young creature, though born in a later stage of development, is yet becoming more and more helpless — a very noteworthy paradox. The young crocodile, which left its mother in the primitive egg stage, yet develops with ease and rapidity under the solar rays, and is by no means an incompetent creature when hatched, despite its tiny size of about six inches. The new-born kitten, on the other hand, though born in a much later stage of development, is very helpless. And if we pass to what we are pleased to call the final stage, we find this helplessness in an extreme form. What could be a more helpless object than a human baby? Nor is this an ephemeral phase. For years the young of the human species are entirely dependent on parental care; a fact which, according to all who have thought upon this subject, has largely contributed to the great and unique development of altruism in man.

It might surely have been predicted, might it not, that as the natal stage of development became more and more advanced in the long ascent of the animal kingdom, the need for altruism would gradually disappear, for the young creature would presumably become more and more able to shift for itself, according as its separate existence began at a later stage? But it must be remembered that, the later the natal stage the longer and more difficult is the ante-natal, period, so that altruism is thereby encouraged in the mother. The greater length of the ante-natal period appears, furthermore, to effect, so to speak, a "coddling" of the young animal, so that the more its mother has done for it in the ante-natal stages, the more it needs and demands from her after its birth. This general tendency seems even now to be manifested. Owing to the average larger size of the skull of infants belonging to the more advanced races, it costs civilised women more to give birth to their children than it costs the savage mother; while the "civilised" baby is even more in need of careful nursing after birth than its savage prototype. If we look back upon the earliest manifestations of the reproductive process, we find practically no exertion on the part of the mother-cell—say, in the simplest protozoa or single-celled animals such as the amœba—while the daughter-cells are competent and selfreliant from the first moment of their independent existence. Of course, it must always cost a mother-cell some effort, even simply to divide, so that we may discover the inchoate stage of altruism even here, as the evolutionary theory would demand; but what an almost immeasurable contrast there is between this effort and all that the European mother does for her child, before, during, and after its birth! Hence we may discover, I believe, the truth which it is the object of this essay to assert, that there is a strict consonance and parallelism between the history of the reproductive process and that of altruism. The essence of each is the making of an effort for something other than *self*.

But let us for a moment attempt to realise the wonder of the reproductive process and of the altruistic sense as they are displayed by the latest development—the mammal. Look at the mammalian mother—when she does her duty—and her child. Evolved by immutable law, here are two products of the dust. We must not forget the significance of their evolution from the dust, for it may help us to scorn that contemptuous attitude towards "brute matter" which stamps a certain pseudo-philosophy. What said Tyndall in that memorable Belfast address of 1874? He quotes the immortal Bruno, burned in the name of the gentle Jesus three centuries ago, as declaring that matter is not "that mere empty capacity which philosophers have pictured her to be, but the universal mother who brings forth all things as the fruit of her own womb." Then Tyndall himself goes on to say: "By an intellectual necessity I cross the boundary of the experimental evidence and discern in that matter which we, in our ignorance of its latent powers, and notwithstanding our professed reverence for its Creator, have hitherto covered with opprobrium, the promise and potency of all terrestrial Life." The mammalian mother and her child, then, are two products of what Stevenson called the "vital putrefaction of the dust"—two discrete agglomerations of the matter and energy which are the manifestations of the Eternal to us. And one of these objects has developed within itself certain specialised portions in which its life-blood is transformed, at no small cost, into a wonderful fluid *designed for the use of the other*. Verily, this is a striking phase of the "struggle for existence." Here is a living thing struggling, and at no small cost, that *something else* shall exist!

So it is that the sublime chapter in which the founder of dogmatic Christianity describes that charity which never faileth, that highest expression of the human worship of Love, finds its more immediate genesis in the breasts of the mammalian mother. The poets sing of the beauty of woman's bosom. Little, indeed, do they know of its beauty. "Science is itself poetic," asserted Spencer long ago. Some day when a poet shall arise with knowledge, and shall sing in deathless verse of the inner meaning of woman's bosom, shall tell us the truth that wakes to perish never—that the maternal breast is the fount whence Love has flowed, who then will dare to say that Keats' last sonnet is as much as we may expect from the poet who is neither superficialist nor sensualist?

And does it not inevitably follow from these broader considerations that the mother, only too common in the present day, who refuses or neglects to nurse her child is sinning against the laws of Nature, and in so doing is avoiding one of her chief "means of grace"? The breasts of a woman are adapted to develop the altruistic sense, the capacity for loving, within her. It is not only her child's loss, but her own, if she declines to avail herself of this rare opportunity.

The philosophy of Herbert Spencer has placed maternity and maternal love on an unapproachable and perdurable pinnacle of glory. In this it resembles Roman Catholicism—which believes that he is burning now. When, with the advent of man, living matter first became *self-conscious*—this is the profound truth underlying the fable about the tree of knowledge of good and evil—there was conceived a conscious code of morality. Concocted and enforced by man, the physically stronger, it has ever been cruelly unfair to woman.

The sum of cruelty and misery that woman, since the dawn of humanity, has had to suffer at the hands of man can indeed not long be dwelt upon by any sensitive mind. Nevertheless, though woman has been the last to benefit by the evolution of the moral sense, she herself has always possessed it in higher degree. Ask me why woman is a more moral being than man to-day, and the answer is easy. Her sex invented morals.

SCIENCE AND SIN

It is a characteristic feature of the modern strategy of orthodoxy to read a symbolical meaning into that which was once accepted, taught, and believed in a literal sense. The method varies with each succeeding decade. We are not likely again to find a champion of the untenable so bold as Newman, who declared that, as long as we do not know what motion is, we may believe the statement of orthodoxy that the sun goes round the earth, and the statement of science to the contrary, to be both and equally true! But defences are still set up, though of a less flagrant kind, for views at least equally erroneous.

Of these there is none more horrible, none more hopelessly at variance with modern thought and knowledge, than the view that we are a fallen race, and that, by the act of our father Adam, we are, each one of us, burdened with "original sin" or "radical moral evil." There is no need to waste time by discussing the details of the orthodox—*i.e.*, neo-Babylonian—view of the origin of sin. We know that it rests upon no historic basis whatever, and that the best evidence for the view that we are a fallen race is to be derived simply from the beliefs of former generations to that effect. It need hardly be said that the natural desire to explain man's disabilities, and the familiar property of the mind by which it tends to magnify the past, are abundant explanation of this myth. The *laudator temporis acti*, still a common type, though modern psychology—did he read it—has so perfectly explained him, was by no means new in Rome. He goes back no one can say how many thousands of years—even long before the writer of the statement that "there were giants in those days"—a very typical instance of this tendency in a very early time. Science, on the contrary, furnishes us with irrefragable evidence, admitted by every impartial person capable of judging it, that the history of man is an ascent and not a descent. The late Professor Henry Drummond, whose lectures to school-boys were a delight to at least one auditor who gratefully remembers them now, has expressed this view in terms familiar to most readers. The only truth, indeed, in the story of the fall is such as may—by a preposterous misuse of language—be read into it from the fact that man is certainly descended from sinless ancestors in this sense that the "ape and tiger" are sinless. We do not impute sin to our pre-human ancestors, nor to their present representatives. But this is not to say that present sinful man has *fallen* from their "high" estate. In preparing this essay for republication I am fortunate in being able to quote the words of

Sir Oliver Lodge in a recent number of the *Hibbert Journal:*

> "This planet has laboured long and patiently for the advent of a human race, for millions of years it was the abode of strange beasts, and now recently it has become the abode of man. What but imperfection would you expect? May it not be suggested that conscious evil or vice looms rather large in our eyes, oppresses us with a somewhat exaggerated sense of its cosmic importance, because it is peculiarly characteristic of the human stage of development: the lower animals know little or nothing of it; they may indeed do things which in men would be vicious, but that is just what vice is—reversion to a lower type after perception of a higher?"

This question of sin furnishes a typical instance of that strategy of orthodoxy to which reference has already been made. Fastening upon the unquestioned truths of heredity, as the fact that an immoral parent is likely to have immoral children, certain apologists are prepared to assert that "evolutionary science positively teaches the doctrine of original sin." On the contrary, evolution absolutely repudiates and stultifies the idea. Asserting the fundamental article of faith in the creed of science, the belief in universal causation, it declares that sinful man—physical and spiritual—is an evolutionary product of the non-moral dust, and of millions of non-moral ancestors. It cannot regard man as inconsistent or incompatible with Nature which produced him, and it realises that to accuse him of original sin is to impute evil to the

Cosmos. From that blasphemy it refrains. Modern philosophy follows the greatest minds of the past, and sees God in Nature and in her product man. With Wordsworth it conceives of a deity "whose dwelling is the light of setting suns, and the round ocean, and the living air, and the blue sky, *and in the mind of man.*" Who, then, will dare to talk of "original sin"?

In other words, modern philosophy offers an unqualified denial to the assertion that man has *inherited* a burden of sin. Man has indeed inherited or evolved a moral sense, a knowledge of good and evil, such as his predecessors had not. So much truth there is in the Garden of Eden story. But the more obvious analysis of that moral sense will show that vice and virtue are correlatives. In other words, the theological idea of sin as an *absolute* thing must disappear. This we shall see when we come to consider the rational and scientific conception of sin; but first let me notice how signally the wisdom of the East has forestalled that of the West in this matter. The orthodox and unphilosophical conception of sin as an absolute thing is wholly Western. Take, for instance, the primitive religion of Japan, and observe its superior wisdom as compared with the ideas of Western theologians—ideas which are contradicted by the patent experience of every one of us every day. The ancient creed of Shintoism—like twentieth-century philosophy—does not regard the passions as evil in themselves, but as evil only in certain circumstances. Further, it regards human nature as steadily tending towards the ennoblement and purification of the passions—which have helped to produce humanity and are absolutely necessary for its survival. In other words, Shintoism and modern science have an optimistic view of human nature, as opposed to the pessimistic view of Western theologians. Not that great Western thinkers may not be quoted as holding this view of sin and evil as relative or negative. It is true that Browning wrote of Christianity:

> "I still, to suppose it true, for my part
> See reasons and reasons; this, to begin:
> 'Tis the faith that launched point-blank her dart
> At the head of a lie—taught Original Sin,
> The Corruption of Man's Heart."

Yet, in a moment of clearer vision, he wrote:

> "The high that proved too high, the heroic for earth too hard,
> The passion that left the ground to lose itself in the sky,
> Are music sent up to God by the lover and the bard;
> Enough that He heard it once: we shall hear it by-and-by."

And the remainder of these magnificent stanzas teach us, in deathless diction, that "the evil is null, is nought, is silence implying sound."

And yet a greater, the most precious gift of the Hebrew race to humanity since apostolic times:

Hear the noble Spinoza, in one of his letters, seeing all things, in his favorite phrase, *sub quadam specie æternitatis:*

> "Evil is not something positive, but a state of privation, and that not in relation to the divine, but simply in relation to the human intelligence. . . . When, therefore, we find an individual whose works are not consistent with this [divine] perfection, straightway we judge that he is deprived of it, or that he is diverging from his own nature. . . . It manifestly follows that the defect which belongs to finite things cannot be called a privation in relation to the intelligence of God, but only in relation to the intelligence of man."

But orthodoxy holds human nature to be essentially bad, and, in order to relieve the Almighty of the onus of such a product, it had to invent that most extraordinary and palpably false of all absurdities, free-will, which is at once a contradiction of the facts of existence and of any consistent conception of Omnipotence. Modern science, like Shintoism, thinks better of human nature—and, therefore, one cannot but suppose, of its First Cause. Among the disasters which have ensued from the orthodox conception of sin as an absolute thing one need only mention asceticism, which—largely under the influence of stoicism, no doubt—has led many noble men and women to devote themselves to the destruction of what they believed to be essentially and fundamentally bad within them, and has thereby robbed humanity of the services of many of its most lovely souls.

What do we mean, then, by saying that sin is a relative thing, and not an original wickedness mysteriously planted, under the eyes of Omnipotent Goodness, in the heart of man? All sin, we may take it, is an expression of egoism—the lust of *doing*, of expressing one's self. There is a difficulty about the use of this word, since it has been used in so many unphilosophical and narrow senses, which have given it a sinister significance. If egoism be essentially a bad thing, then so must be sinful conduct, on our own definition of it. And this is the whole question. Christianity, at any rate by some of its exponents, teaches that egoism is sinful as such. Its sublime Founder taught and practised and died a cruel death for nearly unqualified, absolute altruism. The fact remains that no professing Christian practises unqualified altruism. He eats his breakfast, though his is not the only mouth on earth. He does not turn the other cheek to the smiter. Nevertheless, though we all know perfectly well that unqualified altruism is not only impracticable but undesirable, and though neither cardinal nor archbishop practises or can practise it, neither cardinal nor archbishop has yet had the honesty to confess that which we all know and act upon —that egoism is the correlative of altruism, and that each must combine with and adjust itself to the other in order that the highest results may be attained. In the words of Christ Himself, it is the duty of each of us to love his neighbour *as* himself. Not more than himself, observe. This egoism, this expression of all that heredity and environment have made of us, is not sinful in itself.

Nor are any of its expressions. They have become sinful because human nature—which (despite the opinion of Jeremiah) is *not* desperately wicked, thank Heaven—has developed altruism within itself, and has determined that man is to be a social animal. The idea of happiness for each of us having been gradually evolved from that of the animal, which is content to eat and sleep and procreate, our egoism has to temper itself with altruism. Where the balance is imperfect, there is sin: the expression not of original depravity, but of yet imperfect attainment by humanity of its own divine ideals, or, as Sir Oliver Lodge puts it, "reversion to a lower type after perception of a higher." And what is our failure here but a triumph's evidence for the fulness of the days? Not without hope we suffer and we mourn.

THE FUNCTION OF SCIENCE

One can conceive of science as serving to relieve the probably intolerable ennui of some planet which had no needs and no aspirations. Such is not our state, however, and it ought to be made clear what is the function of science on a painful planet such as this. Intellectual titillation is a pleasant enough sensation, to which science may be made to serve as an efficient stimulus. Such a function, however, is at best ethically neutral; and more probably ethically indefensible. This pleasing irritation of the curious mind of man, which has "sought out many inventions," as Ecclesiastes tells us, plays no unimportant part as a motive force in the case of many thinkers and doers of these and other times; but its satisfaction is an unworthy end in itself. A far higher function is that of cherishing the religious component in man's nature, his aspiration towards the infinite, his attitude of wonder. Says Carlyle, "Does not every true man feel that he is himself made higher by doing reverence to what is really above him?" In a Newton or a Spencer we see clearly enough how high is the rôle of science as a path of reverence. Emerson, in his transcendental way, can conceive of a teacher who should see the identity of gravitation with purity of heart. Wordsworth found in mathematical truth "a type, for finite natures, of the one supreme existence." Yet one cannot but feel that these men are not such because of science. This is their quality of soul, and by it science may be put to such purpose, as by many of us in our measure. But so many others there are in whom science works no such high elevation of soul, but rather the reverse, and in whose case one feels that as far as their personal salvation is concerned they would have been better with poetry, or music, or children, than with facts and formulæ.

There have ever been many eloquently to write of truth, of the love of knowledge for its own high sake, of wisdom as "more precious than rubies"—not in the sense in which Solomon indited that phrase, but as if wisdom had an absolute value. About this attitude towards science or wisdom there is a specious splendour; it seems elevated, detached, academic, impersonal, godlike, philosophic. But in all ages the greatest protagonists of wisdom have been men who saw in it a remedy for human ills. The great philosopher has ever been the true philanthropist: the "lover of wisdom" is the "lover of men." If truth be not in union with the good—if ignorance be bliss—then assuredly 'tis folly to be wise. If your science—which you love for its own sake—is going to prove that there is no hereafter—a question before which science, knowing its own limitations, should be silent—then away with it. What says Stevenson?—"We had needs invent heaven if it had not been revealed to us; there are some things that fall so bitterly ill on this side time!" In other words, if a good-going lie will lighten any one's burden, it has my knee; to Mars or the dogs with so-called truth in such a case. If you have ever stood beside a mother while she watched a baby die, and it has been possible to comfort her with a lie, you did not hesitate to palter with truth to serve her and the hour, and were glad of the chance. This is immoral, some say. Can they prove it so? And so I profess myself a camp-follower of Comte and Spencer and Aristotle, who all agree in this, that the function of wisdom is to minister to the needs of a necessitous earth. I confess to the frankest utilitarianism. If, indeed, you cannot tell Schumann's "Mondnacht" from Luther's "Old Hundredth," or a Turner water-colour from an oleograph; if you are without friends or foes; and if science interests you as such, and is going to make you, and therefore those you encounter, happier, Heaven forefend that you should abandon science; for therein she will be serving, though indirectly, her highest function, which is the furtherance of the good of mankind. Nor do we care how it be done. Whether science merely makes her students nicer to live with; or abolishes the legal crimes which convict a Jane Cakebread one or two hundred times—as if the poor wretch were responsible; or filters your water; or provides you with a machine by which you may speak to your love across the Atlantic so that "the dumb sea-levels thrill to hear"—how it be done matters not, if it be well done.

The justification of all science and all the sciences is therefore sociology; the most difficult and complex as it is the most intimate and, if you consider it, the most extensively studied of all. For each of us lives out his or her own social theories. France, in the person of Auguste Comte, gave us the word. England, however, in the person of Herbert Spencer, has given to the world the fundamental principles of the science. Widely as these philosophers differ, they alike place sociology, in their filiation of the sciences, as the highest but one; ethics, which they regard as the culmination, being a direct deduction—could we make it—from sociology. It is therefore good to know that at last, in the very land of Spencer, there is a Sociological Society. We already have a Numismatical Society—Spencer's irony is very delightful on the subject of numismatics—and, I doubt not, a Philatelic Society: they have their reward. We already have the churches, which attack the problems of sociology from their own stand-point, often with conspicuous success. But in an age when the opinion is beginning to crystallise that a church is either a social force or a social excrescence, it is none too soon that we are to have a properly constituted and dedicated Sociological Society which shall avail itself of the work of all other scientific societies whatever.

Though fifty-seven years have passed since the death of Comte, who gave us the word "sociology," I am told that here and there people may still be met who imagine that the term is a synonym of "socialism." The science of society is the crown and end and aim, and in a sense the synthesis, of all the sciences. There is no need nowadays to assert that there can be such a science, for that has been done, finally, by Comte and Spencer. But it was, indeed, high time that Great Britain, whose universities do not boast, between them, a single chair or lectureship in sociology, should see the rise of a Sociological Society such as is now in process of formation. Its beginnings, of course, will be small, but to it, assuredly, is the future. The Continent and America have their sociological journals and societies. America, for instance, awoke to the existence of the new science some fifteen years ago. Chicago alone has some half-dozen teachers of this subject; learners, too, we may hope they are. For the formulæ and final dogmas of the science of society are very few. It is yet in embryo, but with a promise of a manhood certain, and certainly strong. Sociology asserts that underneath all the questions with which society concerns itself there are principles and laws discoverable by man profoundly rooted in objective truth, and as capable of furnishing guidance to the knowledge of new ways of living as gravitation has been in the finding of new planets.

While sociology is incomparably the most complex and difficult of all the sciences—as it is incomparably the most important—and while it claims for its service the expert in many fields—hygienist, lawyer, economist, philanthropist, biologist, statesman, and many more—yet no one need be an expert to appreciate sociology; and since this is the science of living with one another, and since every one has some degree of first-hand experimental knowledge of this subject, every one may be, in his or her degree, an actual contributor to its development. None of us can live except as a part of the social organism, any more than a single cell isolated from an individual organism can maintain a separate existence. And just as the physiology and pathology of the individual organism are matters of the gravest moment to each of its constituent cells, so the physiology and pathology of society, which constitute the subject matter of sociology, are of the gravest moment to every individual.

The secretary of the Sociological Society, of which the Right Hon. James Bryce, M.P., is the president, may be addressed at 5 Old Queen Street, Westminster. Any one who believes that conclusions of value to humanity may be arrived at by such a society, or that there already exists verified sociological knowledge demanding dissemination, may obtain, by writing to this address, a pamphlet that gives a better idea than I can of the aims and scope of the work. The reader may be assured that the society is no more partisan or sectarian than any other scientific society is; nor is it in any sense exclusive.

If one had a thousand volumes, one might set down a few of the things that sociology has to do. The problems are innumerable, but perhaps most important is the theorem, to use the Euclidean distinction. It is the ever-present and omnipresent question of the man versus the State, individualism versus collectivism. The underlying question is this fundamental one of the man (or the parent, or the family) versus the State. Where Comte and Spencer differ, who shall decide? Certainly not this deponent; but let us just observe what the State does nowadays. It educates, as best it may, the children of the people—an unsound principle, says Spencer. It provides them with mental food, so to put it. But not with physical food. The parent does, or rather does not, that. The present situation is that the State endeavours to teach half-starved or half-poisoned children; and now it is proposed by a great many people, such as Sir John Gorst and Sir William Anson, that the State shall send the child its breakfast when the parent does not—or will not—provide it. To be consistent, the State should feed the child as well as educate it. By the latter process it has already undermined the sense of parental responsibility, and the sooner it takes the consequences the better. It is, of course, a "fag" to teach one's children. It is also, as biography tells us, an incomparable boon to the child—but that does not matter. It is also, of course, a "fag" to feed one's children: for plainly one has more hours in bed or at the piano oneself if the state looks after that little affair.

The answer to such vital questions as this is only to be provided by science. And it is because science does fulfil a function so worthy; because wisdom, like poetry and art and love, is on the side of the angels and the children that one is justified in espousing her and in attempting to sing her praises.

THE FUTURE OF ART

PERCHANCE this volume may fall into the hands of a literary man, or a musician, or some other servant of Art in one of her many forms. And finding it written confessedly from the stand-point of a student of science, finding it full of misshapen and often hybrid terms, finding the tendency to dissection rampant, and utility worshipped more reverently than beauty, he will very naturally throw it down as the work of a vandal and a Philistine whose aims are not his aims and whose thoughts are very far — he thanks his stars — from being his thoughts. But I wish, in all humility, to propound to such a one the theory that he is a man born before his time and that his will be the future. Whatever he may think of other semi-scientific predictions, perhaps he may listen to this one—which is certainly as serious as any of them.

In many ways, we must admit, there is no small antagonism between art and science — between beauty and truth. (If you object that beauty may be true and truth beautiful, I am with you. But the terms must thus be loosely employed for convenience.) And we may illustrate one of the most obvious aspects of this antagonism by quoting a passage from Stevenson, who, by-the-way, has used science so well for his own æsthetic ends:

> "Science writes of the world as if with the cold finger of a starfish; it is all true; but what is it when compared with the reality of which it discourses? Where hearts beat high in April, and death strikes, and hills totter in the earthquake, and there is a glamour over all the objects of sight, and a thrill in all noises for the ear, and Romance herself has made her dwelling among men?"

The implicit conception of art here is the Greek conception that it is the "creation of beauty." In these days, of course, the servant of art would not admit such a definition. There are modern works of art, we know, to which beauty cannot be attributed. We conceive of art as concerned with æsthetics, emotion, feeling; whereas science prefers the "dry light" of reason and "writes of the world as if with the cold finger of a starfish." If science deals with emotion it is only to dissect it and explain it away: so James, of Harvard, explains an emotion as being our "internal sensation" of certain movements which take place within us as the reflex results of the right kind of stimuli. This of Stevenson is the protest, greatly said, that science is taking the "glamour" from things, robbing them of their poetry or emotional value, reducing music to mathematics, creative genius to morbid "association of ideas," love to an irritability of the "anterior horns" of gray matter in the spinal cord.

Hence the righteous indignation of art—if this were true of science. Beauty, moreover, has a quarrel with the implements of science. It sees no cause for admiration in vivisection, for instance. It has no scorn sufficient for the bad grammar of Darwin, the monotony of Spencer, or, indeed, the split infinitives and otherwise slipshod English of most scientific works. That utility may be served by vivisection or bald phrases matters little to the shrinking eye or ear that loves beauty. Art may also affirm that devotion to science tends, in many cases, towards atrophy of the æsthetic sense. Darwin confessed that the years had robbed him of his delight in music and poetry. Whereupon the protagonist of art asks whether the *Origin of Species* was worth while.

Indeed, this antagonism between intellect and emotion sometimes obtrudes itself even when we are trying to give the emotions their highest exercise. If you listen to Wagner with the score—or, still more notably, to such an ultra-complex work as Elgar's "Apostles"—you find that your study of leit-motifs and of modulations, or, in other words, your study of the composer's *science*, is robbing you of the emotional delight you should feel in his *art*. And the time comes when, remembering how the thing stirred you when you had not the score, you drop it and give yourself up unreservedly to the music, nor seek to pry into its construction.

Then, to look at the other side of the case, the contempt of the scientist of the narrow kind for art—the contempt of teleological utility for the beauty which is its own end—knows no bounds whatever. If I were to believe the prophecies of the average modern work on psychology or sociology, or such a book as Max Nordau's *Degeneration*, I should be writing this essay on the "future of art" with a sort of covert grin, believing that it might be disposed of as the witty writer is said to have disposed of his chapter headed "The Snakes of Iceland": "There are no snakes in Iceland." For we are now assured that art has not much longer to go; that there is no time for it, no need for it, and will soon be no desire for it. Art is regarded as a foe to utilitarianism, as a sterile aberration from the path of progress. A recent American writer of very real distinction, Mr. Lester Ward, while regarding art as doomed, actually derides Mr. Spencer for crowning his edifice of the sciences with ethics, and declares that when sociology shall have achieved its ends, ethics—which is conceived nowadays as the question of human relations without reference to theism—will also cease to exist. There will be neither room nor need for it; "everything will be arranged" in accordance with the principles of collectivism; private ethical effort will be as unnecessary as the modern parent conceives private educational effort to be. We shall then have suppressed, you will observe, both the good and the beautiful—both ethics and art—in favour of the true. Enough; let us put a period to this sorry nonsense by an antidote from Tennyson:

"Beauty, Good, and Knowledge are three sisters
That doat upon each other, friends to man,
Living together under the same roof,
And never can be sundered without tears."

The statement, "this is an age of transition," has been true at any time from whatever beginning, and will be true till whatever ending of things we may conceive; but notably is it true of our own epoch and in relation to this very question. This is the age of science, not of art. The present generation is certainly more concerned with truth than with beauty. The prophet of our fathers, who told us that "the great soul of the world is *just*"—rather than beautiful—despised art, as his account of a visit to the opera testifies, though in his own work he could not conquer the great artist within him. True, it was a miserable opera, with a typical libretto, and one can sympathise with him in referring us to the Psalms of David and asking us, after reading them, to go to the opera and hear "what words men now sing"; but Carlyle despised all art, and all science, too, for that matter.

The passing of the belief in personal immortality has bred two kinds of men. To one small group Mr. Swinburne has given voice, in lines which would be remembered for their significance as illustrating one spirit of our day, even if the stupid sort of scientist were right in saying that neither they nor any other beautiful things will be remembered for their beauty alone:

> "From too much love of living,
>   From hope and fear set free,
> We thank with brief thanksgiving
>   Whatever gods may be,
> That no life lives forever,
> That dead men rise up never,
>   That even the weariest river
>   Winds somewhere safe to sea."

The vast majority of thinking men outside Asia, however, will have nothing to do with quietism. They believe—and, verily, they do well—that man's intelligence will make him, in Mr. Henley's words, master of his fate. They see poverty, tuberculosis, crime, "vice," insanity, ennui, and numberless other evils, and they declare that these things need not and must not be. This is, therefore, no time for art, say they; and while preventable evil exists, who dares say that they are not right? One wonders, sometimes, at the opera, whether it is *decent* for all those sleek people to be there, listening to the singers paid at the rate of so many shillings per note, while the cry of the children—unpaid—from the slums round Covent Garden remains unheard. Verily this is no time for art; *except* for those who have the æsthetic sense rather than qualities of intellect or altruism. Let them put out their little seed, their precious talent to usury; another day is coming.

But I cannot surrender to you and declare the glorious future which I see for art without one word of protest against that abominable "cant," as Sir Leslie Stephen calls it, of "art for art's sake." But I will quote to you an artist whom you must acknowledge. Thus says Emerson:

> "As soon as beauty is sought, not from religion and love, but for pleasure, it degrades the seeker. . . . Men do not see nature to be beautiful, and they go to make a statue which shall be. They abhor men as tasteless, dull, and inconvertible, and console themselves with colour-bags and blocks of marble. They reject life as prosaic, and create a death which they call poetic.
>
> "Art has not yet come to its maturity if it do not put itself abreast with the most potent influences of the world, if it is not practical and moral, if it do not stand in connection with the conscience. . . . There is higher work for art than the arts."

I have nothing to say after that!

And as to the future?

As surely as the sun endures, science, knowledge, truth—call it what you will—will one day crush evil, spawn of ignorance, into utter annihilation. *Then* what of art, "the little seed they laughed at in the dark"? Now is the apotheosis of science; but when science has done its work will be the apotheosis of art. For many waters cannot quench men's love of beauty. I am an optimist because I am an evolutionist, and because I am an evolutionist I know that the æsthetic sense is an imperishable and ever-crescent possession of mankind. It will one day be the most precious possession of the many, as it is already of the favoured few. And the many of time coming will know what only very few guess to-day, that science is itself poetic. Has not Tennyson made for himself a separate and lasting place because he found in science a source of Beauty? The critics have not shown us this, but it is so. And when science shall have played her useful part, she will remain as a source whence art and ethics may find inspiration and guidance; for "Beauty, Good, and Knowledge are three sisters": the oak, the stream, the rock, and every other object which science studies, will have their place in the future of art—which will be inseparable from ethics—for the greatest of all artists was right when he saw

"Tongues in trees, books in the running brooks,
Sermons in stones, and good in everything."

TOLSTOÏ AND THE BABIES

PERHAPS it is worth while to consider the attitude of modern science and the philosophy based upon it towards an idea with which we are all familiar—the idea that the "fever called living" is not worth while. The possibility that the human race might come to a sudden and premature end is, of course, not inconceivable. Thus universal suicide has been suggested as a remedy for present ills, and it is obvious that if a majority were bent upon it they might first dispose of the minority before doing away with themselves: not that *that* will ever happen, unless possibly some slow and terrible change occurs in the present environment of human life. We need not fear, at any rate, the coming of a tyrant like that of the past, who wished that mankind had but one collective neck, which he might sever. But two modern thinkers have approached the same question, each from his own point of view. Huxley declared, as he surveyed the lot of his time, that if there were no better prospect in store he would welcome as a desirable consummation the advent of some kindly comet, which should sweep the whole affair away. He would have chosen a different engine of destruction had he been speaking at the present day, for it is quite certain that the earth has very little to fear from a comet, and it is, indeed, said that a comet's tail has already, on at least one occasion, come into contact with parts of the earth's surface. But it does not matter whether we conceive of a solar collision, or the sudden uprush of some irrespirable gas from the bowels of the earth, or any other sudden agent. The question is that of Browning's young lover, "What if the world should end to-night?" Count Tolstoï has his own grounds for wishing the present generation to be the last: which comes to practically the same thing as wishing the world to end to-night. Tolstoï's point of view is very different from Huxley's, for the scientist was an evolutionist, and evolution, within limits, is a gospel of hope; whereas the novelist repudiates all the conclusions of modern philosophy. But without discussing the attitude of these various men, and while recognising that, whatever their conclusions or ours, the stream of babies, at the rate of some seven per minute, will certainly persist, we may try to make some impartial inquiry into the question as a purely academic exercise. "What if the world should end to-night?"

The question we might put to ourselves, I suppose, would centre upon the relative proportions of happiness and pain in human life. If there be more sorrow than joy in the world to-day, and if there be no reason to suppose that the ratio is likely to alter in time coming, then why not end it? Take your "last ride together," like Browning's lover, and let the world end to-night. If, on the other hand, there be a preponderance of joy in human life, then let "the great ages onward roll." Omitting all question as to some "far-off divine event to which the whole creation moves"; omitting all consideration of another life than this, and taking the question as a purely rational and terrestrial one, what course would we pursue had we the power? The answer plainly depends upon the decision as to the proportion between happiness and pain.

But at this point it is plainly necessary to rebut, if one can, the objection that to take happiness as a criterion in passing a judgment upon Count Tolstoï's contention is to adopt a frank epicureanism, utilitarianism, hedonism—call it what you will—which must certainly be defended before one is entitled to proceed. It may be urged that a writer upon this question is bound to take the amount of goodness, and not the amount of happiness, as his test in arguing whether it is well or ill that the human race should continue. But this objection will be made only by those who are unacquainted with the modern ethical analysis of the conception of goodness—or by those who are prepared to impugn the validity of that analysis. For we find, on looking more narrowly into the matter, that the idea of goodness is inseparable from that of happiness: that, do what we may, happiness, in

Spencer's phrase, is "an inexpugnable element of the conception." By happiness we do not mean mere pleasure, but the truest, highest, and most enduring happiness. And we discover that the good action is that which promotes the happiness of others or of self. An action which makes for immediate unhappiness for self is conceived to be good because it conduces to a higher happiness in the future—if not in this world, in another. And an action which is not based upon any prospect of future happiness, either for the individual or for another, is yet conceived of as good, since it makes for the happiness of the Deity: since it "pleases God." Even where the action is one which is utterly fruitless for others, and tends to the destruction of self and the extinction of its highest powers—as in the extreme forms of asceticism—it yet may be conceived as good, since it pleases the diabolical sort of deity whom the ascetic has in his mind. It may be maintained, therefore, that one is permitted to take happiness as a criterion; that all men agree—however different their versions—in regarding happiness, either for self or others or some supernatural being, as the true end of living; and that modern philosophy, which regards God as the eternal power that informs and sustains all things, may subscribe to the teaching of the catechism which asserts that man's chief end is to "glorify God and enjoy Him forever."

Well, I think it might be shown that men are disposed on one side or other of this question according to temperament. I almost fancy that the theologians, the poets—Keats, "here, where men sit and hear each other groan"; Tennyson, "never morning wore to evening, but some heart did break"—and the Hellenists would incline to the view that there is a balance of sorrow in human affairs, and that there is no present indication that that balance is in process of redress. As to the last point, on the other hand, we have a representative scientist like Tyndall declaring that the history of humanity is a history of amelioration, and that the lot of each generation is happier than that of any of its predecessors. And modern philosophy asserts that this crescent nature of happiness might be predicated *a priori* from a broad and evolutionary view of biology. It declares that happiness and pain —or the negation of happiness—are biological forces which help to determine the destiny of all living things. The creature which is not in harmony with its environment will suffer pain and will tend to disappear; whereas that which is most certainly "in tune with the infinite" will be the happiest and the most likely to survive. If we conceive of happiness as conditioned by adaptation to conditions, and of this process of adaptation as fundamental in the evolution of living things, we see that happiness must surely be increasing as the adaptation becomes more perfect; that with a more perfect adaptation of man to his environment the balance of happiness will increase, while pain ever remains as the warning and preventive of any tendency to depart from this more happy adaptation. Therefore the evolutionist—and we are all evolutionists now, for we cannot escape our mental environment, even though we have not given it a name—must necessarily believe that the sum of happiness is ever crescent. It is, indeed, on the assumption that happiness usually outweighs pain that our conceptions of good and evil are framed. If there were more pain than happiness in life, on the average, the good action would surely be that which tended to the death of another: just as it is good to put a hopelessly wounded creature "out of its pain." But let us look at the history of humanity—as the biologists and not the historians call history.

Man as we know him is the latest product of a long series of lower forms, whose capacity for suffering—and for happiness—was smaller than his own. I will not attempt to answer the question whether the life of a cow, let us say, is or is not happier, on the whole, than the life of a typical East-ender. Nor will I attempt to decide whether civilised man is happier, on the whole, than savage man, with his much smaller capacity for physical pain and his entire mental ease. But I do certainly believe that if we take the history of civilisation Tyndall's words are justified. Perhaps we owe our happier lot, as compared with the Middle Ages, to the ethical ideal of the Church, perhaps to other causes. But whatever the verdict of Tolstoï or any one else on human society as it is at present, I fancy that a healthy man would rather be alive than dead, rather human than simian or vegetable. It is not begging the question to say a healthy man, for disease as a great factor in human affairs is assuredly doomed. Tuberculosis and malaria, the two most deadly of known maladies, may be disposed of whenever the race pleases.

But you will tell me that disease is relatively a very unimportant matter; that the evil in the world is not material but moral; that "highways of smooth electrical ease" and pure milk are hardly enough to end the *Weltschmerz;* that if you probe the malady to the bottom it is human nature that is "desperately wicked"—as Jeremiah and the theologians assure us; and that human nature is the same in all ages, so that any millennial dreams may be discounted forthwith. And I agree with all but your last assertion.

If there is any popular and academic error which modern knowledge and wisdom have totally and finally exposed, it is that "human nature is the same in all ages." We believed that glib assertion up to the time of Comte. The man to whom we chiefly owe the assertion and proof that human nature is *not* the same in all ages is Herbert Spencer, though a serious monthly magazine, in the number published after his death, began its first page with that shallow and hopeless lie. One still sees it everywhere, and never without an effort—usually ineffectual—to restrain the utter contempt and disgust which it inspires. At this time of day there is absolutely no excuse for it whatever. It is repeated by those who have never looked into the facts upon which it is supposed to be based. A relic from a time when Genesis was history, it should be taught to some glib parrot in each generation—for human lips are too good for it — and should be remembered only as a measure of the hopelessness from which the nineteenth century rescued the noble aspirations of men.

Human nature was once simian, once amphibian, once much lower still. The ridiculous assertion which many of us still believe—and quote, as if it were wisdom—is historically coeval with the ridiculous chronology of Archbishop Usher. If man was, indeed, created, as the learned divine has calculated, at nine in the morning on the 21st of October, in the year 4004 B.C., then certainly we cannot demonstrate much alteration in human nature during the past six thousand years. But that has gone the way of all myths, and has been replaced by a gospel of hope: hope not merely for the individual but for the race. And it is because human nature is responsible for humanity's greatest evils, and because I know that human nature is ever climbing "the world's great altar-stairs, that slope through darkness up to God," that I believe Count Tolstoï—who despises and denies evolution and its exponents—to be wrong. I give you Tennyson, the one great artist who, so far, has discovered evolution:

"Red of the Dawn!
Is it turning a fainter red? so be it, but when shall we lay
The Ghost of the Brute that is walking and haunting us yet, and be free?
In a hundred, a thousand winters?
Ah, what will *our* children be,
The men of a hundred thousand, a million summers away."

If life is not worth living to-day, it will be *then:* so we welcome the babies, Tolstoï notwithstanding.

THE FIRST EVOLUTIONIST

It is commonly said, though without an iota of justification, that the adherents of modern science are never so happy as when engaged in iconoclasm; that they are utterly without reverence for the great achievements of distant ages; and, especially, that they care nothing for and know nothing of the magnificent achievements of ancient Greece. But this is simply not true. The modern man of science, if he be anything more than an expert laboratory "hand," is well aware of his indebtedness to Greece, and has his idols among the great of that race no less respected and wondered at than those of the academic philosophers. But they are not the same idols. With all our respect for Socrates, Plato, and Aristotle, and with all our acknowledged indebtedness to the great mind of Aristotle in especial, we who adopt the criteria which modern science has given us own our prior allegiance to other names possessed of a still greater antiquity; and while we bow as all must before the story of the death of Socrates (finding in it not a little support for that principle of tolerance which modern science has so greatly helped to establish), and before the poetic genius of Plato, and the great mental qualities which coexisted with the almost incredibly careless observation of Aristotle, we cannot help regretting that certain of their predecessors should have had so much less influence than their work deserved upon the intellectual history of mankind. And in the light bequeathed to us by the nineteenth century it is of interest to see, if we can, how far the greatest of ancient philosophic schools had reached out towards that idea of universal evolution which was to wait for nearly two and a half millennia before receiving new and final expression in Spencer's masterpiece, *First Principles.*

Heraclitus of Ephesus was born about the year 535 B.C. The fragmentary state of his works and the obsession of academic thought by his critic Plato are largely accountable for the comparative obscurity of his name. He enunciated, as the principle of the universe, "Becoming," and, together with this leading idea, he upheld the great principle of continuity, the law of eternal consequence, which is implicit in all modern thought. Everything to him is in a state of eternal flux; all things are, yet nothing remains.

Like all the real makers of thought, Heraclitus has suffered greatly from the misrepresentation of his critics—a consideration of no small comfort to some of us who writhe under the grotesque and puerile conceptions which certain contemporary critics entertain of the last evolutionist. Even Plato systematically emphasised those supposed

Heraclitean doctrines which least truly represented him: and the great thinker of Ephesus suffers still. The very biographer who makes this acknowledgment concerning Plato, and attributes to this cause the many centuries during which the real worth of Heraclitus has been ignored, himself declares of the principle of "Becoming" that it implies "that everything is and at the same time and in the same relation is not." One wonders how much longer such playing with words will be tolerated in a serious world. But doubtless this critic wrote under the influence of the unfailing bemuddlement of Hegelianism, forgetful that punning is the lowest form not only of wit but of philosophy.

Already we find in Heraclitus an idea characteristic of evolution, which is ever a Becoming. Furthermore, Heraclitus had, in part, the idea of rhythm which is an essential part of the Spencerian system. Fire he conceived to be the principle of all things, and, as everything came from fire, so to fire must all things return. This may almost be regarded, with a considerable strain of the meaning, as an anticipation of the nebular theory, which was Spencer's type of evolution in the inorganic world—insisted upon when all the astronomers of the time denied it. For if we think of the primitive nebula, from which the solar system is formed, as a great "fire-mist," and if we remember the probable end of the solar system, dissipated by collision with other bodies in space into such another "fire-mist," we are almost entitled to regard the idea of Heraclitus as foreshadowing an important part of the evidence for the theory of evolution. It is necessary to add that the "fire-mist" idea of a nebula is quite erroneous. On the contrary, the primal temperature of a nebula is very low. "Fire" develops in it only as a result of the heat gained by the shrinking of the nebula due to the force of gravitation.

In his conception of ethics, also, Heraclitus went far in the direction which Hegel and Comte, without the guiding principle, and Spencer, with it, have later trod. "The law of things," he says, "is a law of Reason Universal, but most men live as though they had a wisdom of their own." Ethics was therefore to him the crown of his system as it was that of Spencer's. Sublime, indeed, is this conception, entertained twenty-five centuries ago, of virtue as grounded in the harmony which Heraclitus saw in nature. Nothing in the synthetic philosophy gives greater pleasure to the reader than a similar demonstration, often repeated, that the laws of morality are grounded in *Universal Law.* To find, for instance, that the laws of sexual morality, as variously perceived by men and taught with the authority of all kinds of religious systems, are grounded, as Spencer has shown, in a fundamental biological law—are verily as deep as life—is to reestablish one's faith in the music of the spheres and in the absolute congruity of the Cosmos. All honour to Heraclitus, who anticipated, so long ago, the recognition of this sublime truth.

So obscure was Heraclitus—in contradistinction to the last of his school—that he was surnamed the "dark." What would not modern thinkers give for a complete edition of his works—annotated by himself, and not Plato? We have to make the best of such aphorisms as these: "You cannot step twice into the same river, for fresh waters are ever flowing in upon you"; and "Man's character is his fate."

There is no evidence that Heraclitus possessed the power of exact thinking, the cosmic grasp of intellect, or the sound method of the great Englishman whom all the thinking world honours to-day; but in so far as he may legitimately be regarded as having reached out, however blindly, towards the goal which human thought gained last century, so far is he worthy of honour and remembrance when so many of his fellow-countrymen are passing into the oblivion from which a mistaken conception of philosophy as an *a priori* exercise of the human mind has so long rescued them.

Like Herbert Spencer and his opponent Carlyle, who will always be remembered for having called him "the most unending ass in Christendom," Heraclitus believed that "the great soul of the world is just," and like the many evolutionists, of whom he was, as far as we know, the first, he laboured, verily not without success, to read upon the face of nature the laws that will some day resolve into harmony all discords between her tones and ours.

One other great name must be bracketed with that of this noble Greek—the name of Gautama the Buddha. Scholars cannot tell us to within half a century the chief dates of the Buddha's life. Possibly he was an actual contemporary of Heraclitus, possibly he preceded him by some forty or fifty years. As far as students can judge, there is no reason to believe that any of the Greeks travelled as far as the valley of the Ganges; so that they owed nothing to Gautama. Heraclitus certainly stands as an ancestor, in the direct line, of modern science, though accidental causes prevented him from having any direct influence on the subsequent lives or thoughts of men. His Indian contemporary or predecessor, however, has profoundly affected hundreds of millions for many past generations, though Occidental thought owes nothing to him. Gautama recognised, as did Heraclitus, the great principles of causation and ceaseless change, while his life of purity and self-abnegation makes him more than worthy to be placed beside the great thinker of Ephesus. Gautama did not much concern himself with speculations on the nature of the physical world. The law of change, as he saw it, applied to man rather than to external things. Species and elements were constants to him, so that in this regard he is not to be considered as an evolutionist. Yet he had most clearly the conception of Being as a process, or becoming, the individual being to him a congeries of processes. He had not the conception of the One

Supreme Reality, the Changeless Eternal that underlies the temporal, such as we find it in Spencer; the idea of becoming expressed to him the whole of reality: but we may readily admit the claim set up for him by Professor Rhys Davids to be regarded as one of the pioneers of evolution.

And we who walk in a light which Heraclitus and Gautama served in part to kindle twenty-five centuries ago may remember their names with something of that reverence which is their meed.

HERBERT SPENCER

HERBERT SPENCER was one of the first to insist upon the unimportance of the mere biographical details that many people find so interesting and vital. Most of such details are what, with his genius for language, he called "dead facts," incapable of forming part of "organized knowledge" (which was his definition of science), and therefore to be relegated to a secondary place. Nevertheless, such details, well handled, may have a high, indirect value. If some one with literary skill were to study Spencer's *Autobiography*, and then write a comparatively short essay upon his life, introducing the good stories, making much capital out of his relations with George Eliot, not forgetting to observe that he persuaded her to try her hand at writing novels, and carefully including all the gossip and tittle-tattle which could be obtained from other sources, he might make a story so interesting and attractive that some small percentage of his readers would be tempted to take an interest in the man's *work*. The facts would not then be altogether dead, for they would have incited a few to study the facts that are truly living.

But the present writer, who would give a good deal for the art wherewith to write such an article, can attempt only to discuss the work itself, hoping that he may be able to do it something approximately like justice. And we can hardly do better than begin with an account of the idea contained in the word "evolution"—one of the many terms, now invaluable, which we owe to Spencer: while about none is there more general misconception. The word was formerly employed to denote a particular theory in embryology. Spencer's adoption of it to express his own idea has really added a valuable new word to the language—a word so indispensable that even Dr. Caird, the master of Balliol, always a leading opponent of Spencer, has been unable to do without it in the titles of all the works that have come from his pen for many years back. Indeed, it would be easy to show how Spencer's opponents are unable to attack him, or even do any of their own "independent" thinking, without using his terms and ideas as the key and clue to their mental operations.

It was while reading over his various magazine essays for republication, in 1858, that Herbert Spencer made the chief discovery of his life. He discovered that there lay, implicit though not explicit, in these essays a cosmic law of the widest generality and the highest importance. Would that some little folk who republish essays could make a similar discovery! That principle he called the law of evolution, and he determined to devote the rest of his life to it: with the result known to all the world. The doctrine of what we now call *organic evolution*—usually associated with the name of Darwin—Spencer had adopted and advocated six years before. The idea that species are not immutable creations but derived from simpler forms was at least half a century old. It had been advocated by Lamarck in 1801, and hinted at by a biologist almost equally great, the versatile Goethe. It is admitted by his opponents that Herbert Spencer was the first independent thinker to adopt this view, which he did when all authority, such as that of Sir Richard Owen, was against him. But he did more, even at that early period, in asserting the development of living from not living matter. In this he was at least half a century before his time. This assertion was, of course, implicit in the doctrine of universal evolution which he, and he alone, named and conceived—discovering it, as I have said, by having occasion to read through, at one time, his own scattered essays.

Thereafter came the work of Darwin and Wallace. Neither of them concerned himself with the origin of life, or with any other question but this one: Have species arisen by the selection of "favoured races" (Darwin) in the "struggle for existence" (Wallace)? In his great masterpiece, the *Origin of Species by Natural Selection*, at which he had been silently working for nearly twenty years, Darwin set himself the task of answering this question in the affirmative. He neither raised nor answered any other question. Spencer at once discovered in the work of the older man (Darwin was born in 1809, with Tennyson, Lincoln, Gladstone, and Mendelssohn) a proof of one relatively small but very important phase of evolution. He immediately utilised "natural selection" as one of the bulwarks to his theory, illuminating it with the phrase, "the survival of the fittest." Darwin's own term was "natural selection," an ambiguous and unsatisfactory phrase, which did not by any means explain itself. In later editions of his work he adopted Spencer's paraphrase. Between these three men, Spencer, Darwin, and Wallace—among whom there might well have been much wrangling and jealousy—there was never anything but harmony, generous recognition of one another's claims, and appreciative utilisation of one another's work. Since that day biologists have spent infinite labour upon Darwin's theory. It is probably more than doubtful whether natural selection is of such importance as he supposed; but nothing could be more erroneous than to suppose that the assaults upon it have in any way weakened the theory of organic evolution. While natural selection certainly does act, biologists differ merely as to the relative importance which they attach to it. And whatever the ultimate verdict, Darwin's merit is none the less.

One need offer no excuse for a slight digression concerned with the history of this idea. We hear of it first in Empedocles, the pupil of Democritus, though he applied it in quite a different sphere. Desiring to account for the combinations and separations which occurred, according to his master, in the history of atoms, Empedocles declared that those combinations maintained themselves that were suited to their end (or, as Spencer would say, "adapted to the environment"), while unfit combinations, having no proper environment, must disappear. And now radium has appeared to verify the speculations of this Greek of twenty-three centuries ago. As applied to the origin of species, the idea first appears in an "Essay on Dew," read by a physician, Dr. Wells, before the Royal Society in 1813. It was independently reached thereafter by Mr. Patrick Matthew (in a work on naval timber), by Spencer in relation to societies (*Social Statics*, 1850), and by Darwin and Wallace. Of these two last, each has told us that the idea was reached by reading Malthus. It may be noted that the idea occurred independently to five different persons within less than half a century, all living in the same country. This is an excellent instance of the manner in which the raw material for ideas is "in the air," ready to be developed by whosoever shall be concerned with it.

There needs no apology for quoting in full Spencer's famous definition of evolution, which is familiar to all philosophical thinkers and constitutes the essential legacy of the nineteenth century to subsequent ages. Here, in its most abstract form, is the formula which its author applied to all the phenomena of the Cosmos, from the making of a planet to the making of a society or an art: "Evolution is an integration of Matter and concomitant dissipation of Motion, during which the Matter passes from an indefinite, incoherent homogeneity to a definite, coherent heterogeneity, and during which the retained Motion undergoes a parallel transformation." At the beginning of his thirty-six years' task — pursued with superb courage under the most disabling ill-health—Spencer saw that he could not expect to discuss the application of this formula to the inorganic world. He therefore passed at once from the elucidation of his *First Principles* to their application in biology, wisely leaving to lesser minds the discussion of their application in the simpler realm of inorganic nature. He just lived to see evolution justified in its entirety in the inorganic world. Within the last few years the nebular theory of the solar sytem, which he supported *contra mundum* some fifty years ago, has been established upon a mathematical and therefore inexpugnable basis. Even more remarkable is the case of the newly discovered element radium, the phenomena of which answer to the Spencerian definition of evolution as if it had been framed to explain them. In the atoms of radium we have an "indefinite, incoherent homogeneity" which gives place under our eyes to a "definite, coherent heterogeneity" with "concomitant dissipation of motion." I am not aware that the extraordinary aptness of this illustration has yet been commented upon, and it would be interesting to know whether it was brought to Spencer's notice.

One can realise the magnitude and value of the idea of evolution only by looking at the different branches of contemporary science. At the present time the chemists and physicists are all agog about *atomic* evolution, which has lately become as certain a truth as organic, stellar, or social evolution. Species are not immutable: not even species of atoms. And while children gape at the price of radium, the whole scientific world is thanking it for having supplied the final proof that evolution applies to the very "foundation-stones" of the material universe. As for the astronomers, they call the study of stellar or cosmic evolution the "new astronomy." To every one but the mathematician, and to him also when he looks at its significance, this is infinitely more interesting and significant than the older astronomy, primary and invaluable as that certainly is. The human intellect can hardly contemplate a more stupendous subject than the "redistribution of matter and motion" as seen in that which so deeply affected the noble soul of Kant—the starry and illimitable heavens. Evolution applies to a nebula billions of miles in distance and extent as it does to the ultra-microscopic atoms of which that nebula is composed.

And the main problem and principle for the biologist of the present is exactly parallel with those of the astronomer, the chemist, and the physicist. They are all agog about *organic* evolution, which reached a new stage in public acceptance just after Spencer's death. The Christmas lectures *for children* delivered by Professor Ray Lankester at the Royal Institution purported to deal with "extinct animals." As a matter of fact, these were really lectures upon the overwhelming evidence derived from geology and palæontology in favour of the theory of organic evolution. Quite a new experience for future Eton boys, many of whom will subsequently have to study the writings of Paley for entrance into Cambridge University.

Then, again, the pathologists. No question interests them more deeply than that of cancer and the other forms of malignant growth. Many years ago they were told by a distinguished English physician, Sir William Collins, that they would make progress in this matter when they went to work in the light of Spencerian principles. Within the last few months Sir William Collins has had the pleasure of seeing his prophecy fulfilled. A botanist, Professor Farmer, aided by Messrs. Walker and Moore, decided to take up this question from a broad and philosophical stand-point. For many years he had been studying all sorts of cells—as from men and mice and lilies. Guided by such principles as that of adaptation to environment, he and his helpers have succeeded in making the most important discovery regarding malignant growths that has been recorded for many decades. He has shown that the cells of any form of malignant growth go through a process of division which is characteristic of the cells destined for *reproduction;* and he has entirely disposed of the well-worn theory that cancer is due to a parasite. No one who has looked into this question will disagree with Sir William Collins's opinion that the Spencerian biology may justly claim to have been the influence that indirectly determined this discovery.

One could cite further instances without end—taken from the educationists, the sociologists, the psychologists, and so forth—to show how widely and fruitfully the influence of Spencer's work has permeated contemporary science. But surely there is no occasion to do so here. Putting aside the opinions of critics without a vestige of a claim to a hearing, we may surely accept without demur the words of one whose name will ever be remembered as that of a fearless and successful seeker after truth, the illustrious Darwin, when he called the subject of this essay "our great philosopher." Perhaps that opinion is worth as much as the gibes of a whole host of nonentities.

Is it, then, surprising that all the chief organs of the French press should have found a fertile topic for comment in the ignorance and apathy of the British people when one of the immortals passed from among us? Perhaps the *Débats* was hardly within the mark in saying that if Spencer had been "un jockey heureux, un cricketer, ou un foot-baller distingué," his death would have excited more notice than it did. But had our neighbours waited a little they would have found ample excuse for all their satire. Nothing would have astonished them more than this, that none of the "critics" betrayed any acquaintance with the man's *work*. They all had stories to show his brusqueness, his superficial unlovableness, his unquestionable egoism; some of them had quotations from little contemporaries — as that Spencer is "the philosopher of the half-educated" (a saying which came well from an academic philosopher who once wrote to Spencer for a testimonial)—and a few of them had acquaintance with some Spencerian phrases. That was all. Not one of his critics ventured to state the nature of Spencer's failures or defects, save in so far as these defects were personal. So much for current criticism! As to the nonsense we have heard, let these examples suffice. Principal Fairbairn, of Oxford, says that his philosophy will be dismissed by posterity as that of one who was a poet and a dreamer rather than a thinker. Another writer says he was not a man but an intellect. These may be left to one another. I have myself been challenged—by one who had not read ten pages of Spencer—to adduce "a single idea" from him, but a writer in a daily paper has essayed a costly immortality by describing Spencer as an industrious plodder rather than an original thinker, and by adding, in a phrase at which the centuries would laugh if it reached them, that *First Principles* is not wholly destitute of "a oertain literary power." This of a book for which science and philosophy had been waiting since the dawn of thought, and which the forty most active years in the history of man's mind have since established by telescope, spectroscope, microscope, by processes mathematical, experimental, logical, and by all other processes whatever, as essentially part of inexpugnable truth.

Of course your true metaphysician — nourished on the Hegelianism which Germany has done with and passed over to Oxford, adopting Spencer's philosophy in its place—will have none of all this. A book like *First Principles*, which deals only with *phenomena*, and declares reality unknowable, is not in his line. He much prefers the discussion of essentially insoluble problems, such as that of the origin and nature of Reality. The man who merely "unifies the whole knowledge of man," to use Spencer's own phrase, is not good enough for him. Long ago Spencer showed—and the history of thought is witness that he was right—that the problems of metaphysics are insoluble; and this is how one of his critics disposes of him therefor: "A failure to solve the problems of metaphysics must always remain a failure, in spite of all protestations that it was inevitable." Sir Oracle, indeed!

The only part of *First Principles* which interests the metaphysicians is naturally the first section, dealing with the "Unknowable." The knowable does not interest ontologists. With the academic criticisms of this first section we need not concern ourselves: they are of the value indicated by the specimen quoted, T. H. Green's criticism, in particular, being the most remarkable instance of sustained "philosophical" punning with which I am acquainted. But Green was an apt pupil of the greatest punster of them all. The doctrine of the unknowable, with its remarkable affinities to the teaching of Spinoza, is too profoundly important to be omitted in any book which professes serious aims. I have dealt with it in another essay. Here we may raise a totally different consideration.

The details of Spencer's work, in a certain number of instances, furnish a happy illustration of the Baconian dictum that truth is more easily extricated from error than from confusion. When he erred, he at least continued to be intelligible, and his errors have therefore proved of very great use in leading indirectly to the truth. The chief of these errors, as we discern them to-day, must necessarily be alluded to in this essay. I wish to show where he failed, not that I pretend to admire the motives which cause little people to yap at great people—whom, of course, our imperfect comprehensions can only imperfectly comprehend—and not without recognising that a review of the errors and mutual contradictions of his now-forgotten critics would be much more amusing—but because the study is of interest in the light of the Baconian aphorism.

Let us first take the subject of psychology, of which Spencer is a universally acknowledged master. When faced with the old problem as to whether our knowledge is all derived from experience or is partly *a priori*, Spencer concluded that all our knowledge and forms of thought are *a posteriori*—*i.e.*, the result of experience—*for the race*, though certain of our ideas are *a priori for the individual.* It was impossible, as he thought, to explain such conceptions as those of space, time, motion, etc., as derived from individual experience; he therefore concluded that such ideas are the result of long-drawn racial experience, and that the individual inherits them as *a priori* forms of thought or "innate ideas."

Few of Spencer's thoughts have been more admired than this—even by those whom academic prejudice caused to oppose him in everything else. And the idea is, in part, a true explanation of certain facts. Undoubtedly the experiences of our race have led to the development of nervous structures of many kinds, which our ancestors have bequeathed to us. This heritage has enabled us very greatly—incalculably, indeed—to profit by their experience. But it can no longer be contended—especially as there is no longer such need to contend—that any of our ideas are actually inherited by us, being therefore *a priori* or innate to us, though experiential to our predecessors. As far as the actual origin of our ideas is concerned—apart from the origin of the structures which enable us to entertain such ideas—this much-admired argument of Spencer is palpably a compromise.

It certainly appears to explain away our difficulties, but it has an unphilosophic look about it, and subsequent psychological and biological study has disposed of it. Certain of the ideas, such as that of space, which Spencer thought to be incapable of analysis, have been successfully analysed since he wrote, and modern psychology is assured that Locke was right and that all our knowledge, including the very forms of thought, is the product of individual experience, though Spencer was right in conceiving the organs which make much of our knowledge possible to have been developed through the experiences of our ancestors. Innate ideas are a myth. Knowing that this conclusion is now some decades old, it was of special interest to me, when seeking for the contemporary Oxford view by reading Professor Case's long, lucid, and deeply learned article on "Metaphysics" in the new volumes of the *Encyclopædia Britannica*, in which, of course, he successfully demolishes every metaphysician that has ever lived, to find that his one good word for Spencer consists in referring to this largely exploded view as a "brilliant suggestion," to which he later reverts for its supposed value.

The ancestral-ghost theory of the origin of religions must also count as, at any rate, a partial failure. No one would care to assert that religions never arose in the manner supposed by Spencer; but, on the other hand, no one would now support him in the view that this and this alone was the manner in which religions arose. Probably Professor Tylor, of Oxford, has added much more to our knowledge in this matter than Spencer did.

Most of us know that, in the words of the first number of Mr. John Murray's admirable new magazine, *School*, Spencer was "the great educational reformer of the nineteenth century." But he was a rigid and absolutely uncompromising opponent of State education, and prides himself, in his *Life*, on remaining so at seventy-three, though conscious that practically the whole world was against him. Of course, this is not a matter to be decided off-hand; but, at any rate, few can deny that there is far more to be said in favour of State education than Spencer cared to recognise. Palpably though it has failed, in Great Britain, to do all that it was hoped to do, yet the experience of thirty years seems to show that it has, at any rate, tended towards the reduction of crime. The parallelism between illiteracy and criminality may reasonably be supposed to bear this interpretation. The opponent of State education has to face the fact that it is surely better for children to be thus educated than not be educated at all. This is the alternative in only too many cases, while the parental sense languishes among us. Spencer might retort that our State education tends towards the atrophy of the parental sense, and it can hardly be denied that his counsel is, at any rate, one of perfection. Yet he himself recognised the principle of expediency in his toleration of and sympathy with religious organisations which he believed to be founded on something other than truth; and that principle seems to apply here. Some of us fancy that State education, lamentable rubbish as much of it now is, may one day so teach children, aided by a moral education which cares little for Old Testament "history," as to restore the sense of parental responsibility and ultimately to enforce a general recognition of the truths that the supreme end of education is character-making, and that, therefore, the parent is the naturally ordained educator.

Closely allied to this was Spencer's opposition to compulsory vaccination. He went into this matter when the utility of vaccination had been proved as conclusively as anything outside mathematics can be proved, yet came to the conclusion that vaccination is useless. Of course, every one knows that, both in this instance and the last, Spencer was biased by his view of the duties of the State. His *laissez-faire* individualism was a heritage of his youth, and it seized upon his mind with never-relaxed tenacity. It is interesting to me to trace the history of the conflict in Spencer's mind between this political doctrine which he had inherited and the doctrine of evolution which he had himself evolved. The victory went to the older and more deeply rooted conviction. For it is perfectly plain to us that the modern extension of the functions of the State—such as teaching children and protecting them against disease—might conceivably have been predicted centuries ago by any one who had the formula of evolution as part of his mental equipment. The law of specialisation which Spencer worked out with such invaluable results in so many other directions must apply here also, on his own assumption that evolution is a universal process. Hence the curious result that later thinkers, without his early bias, but entering unbiased into the heritage with which he dowered them, have almost unanimously rebutted their teacher's conclusions as to the functions of the State in this and many other directions.

Of course, I am not so foolish as to assert that of the thousands of ideas and conclusions which Spencer left us there are not several others that have yielded to the criticism of men who have made a life-study of the particular branch of thought to which they relate; but I have tried to select the most conspicuous and important instances in which various details of the synthetic philosophy are being modified. As its author once said, when some enthusiastic admirer, who had somehow missed the whole lesson of the law of evolution, declared that it would last forever, "Shall my words be the only things in the universe that do *not* evolve?"

And here let us look at one or two of Spencer's root-conceptions; and, first of all, his conception of philosophy. Some of us remember learning at school that the Latin word *res* had about two hundred different connotations. In our time there can be no doubt that the word which conveys the greatest number of different meanings to different people is the word "God." The recognition of this fact would render superfluous many vain controversies and would show the absurdity of such unqualified queries as "Do you believe in God?" Similarly, the word philosophy has many different meanings. Originally adopted as a modest title in contradistinction to the name of sophist arrogated by a certain school of thinkers, the term has passed through many stages—nor is there any conclusion yet arrived at. Such terms as natural philosophy—for physics—and mental and moral philosophy—for psychology and ethics—still persist; while we still see the legend "maker of philosophical instruments" upon shop-fronts. The reader may remember the contemptuous scorn with which Hegel observed that in England a microscope was called a philosophical instrument. Science and philosophy were two totally distinct things to him.

The popular notion of a philosopher, again, appears to be that of some one who is not concerned with the pleasures or pains of life, some one divorced from all mundane interests — in short, a stoic. Illustrative of this is the story of Mr. Carnegie's surprise on hearing Herbert Spencer demand Cheshire instead of the Cheddar cheese, which he had not ordered.

The academic notion of philosophy may readily be defined. Scornful of mere science, the official philosopher regards philosophy as a term to express the study with which Aristotle concerned himself after writing his *Physics*, and which his followers therefore called metaphysics. A more modern term is *ontology*—the science of being, or the study of ultimate reality. The three words, philosophy, metaphysics, and ontology, are used as synonyms by academic writers. It is highly to be desired that only *ontology* should be used to convey this meaning, for which its derivation fits it. The beautiful word philosophy may then be spared for other purposes.

It will be seen, of course, that those who take philosophy to mean a study of ultimate being or reality will deny the title of philosopher to any one who concerns himself with anything else. Newton was not a philosopher in the eyes of Hegel, who furiously and foolishly attacked his immortal discoveries of gravitation and the nature of colour; nor are Comte and Spencer philosophers in the eyes of the ontologists, since they deny the possibility of ontology and confine themselves to studies of merely relative reality.

Now, if the ontologists, after more than two thousand years, had any results to offer us; if they could tell us anything whatever as to the essential nature of reality; or if they afforded us any indication, however slight, of ever being able to do so, we should rightly concede to them the exclusive use in the title of philosopher, recognising that such an achievement would give them a just claim to regard their study as the only true wisdom. But it is a matter of notoriety that the ontologists have as yet achieved nothing; that metaphysics, as Mr.

Haldane has recently admitted, is to be regarded as a species of poetry—of an order how bereft of everything that makes poetry a power and a joy!—and that there is grave reason to suspect that ontology is, by the nature of the case, impossible, the attempt to explain consciousness by itself being on a par with the attempt to lift one's self by one's own collar. In recent times psychology has analysed the phenomena of mind in such a manner as forces us to the conclusion that there will ever be an insoluble mystery underlying all our knowledge, or, in Spencer's words, that "the Power which the Universe manifests to us is utterly inscrutable."

We may therefore regard ourselves as entitled to use the term philosophy in a sense which the ontologists do not recognise; and to call philosophers those who deal with that which may be known. While recognising that the ideas generated in us by the outside world are not absolutely true, we may unreservedly surrender ourselves to them as capable of yielding us relative truth.

What, then, is the conception of philosophy entertained by the only Anglo-Saxon who has yet written a *System of Philosophy?* And is it a conception which, after nearly half a century of unparalleled mental enlightenment, we may regard as valid? Denying the possibility of ontology, can we assign to the term philosophy any meaning deeper than that given to the term science—when this is used to include "organised knowledge" of all kinds, history and Biblical criticism as well as physics and biology?

Observing that philosophy, however variously conceived, always means a knowledge which transcends ordinary knowledge, and that it does so in virtue of its breadth as having a higher degree of generality than any other, Herbert Spencer declares that "the truths of philosophy bear the same relation to the highest scientific truths that each of these bears to lower scientific truths." The generalisations of philosophy comprehend and consolidate the widest generalisations of science. Knowledge of the lowest kind is *un-unified* knowledge; science is *partially unified* knowledge; philosophy is *completely unified* knowledge. His conception of philosophy was that of a *synthetic* process; his aim being "to unify the whole knowledge of man."

It is in this conception that Spencer differs entirely from the metaphysicians, as does his great predecessor Comte, and as, in part, did his still greater predecessor Aristotle. Great as were his deductive powers, he was essentially an inductive thinker. He thoroughly realised the distinction between the mode of thought that starts with *facts* and that which starts with *words*. As an instance of his method we may take the *Descriptive Sociology*, which lack of public support compelled him to abandon, but which is now to be completed. He saw that valid sociological generalisations could be based only upon a sufficiently wide collection of the *facts* about different societies; and he spent many thousands of pounds in the collection of them.

This quotation from a letter is worth reading:

> "Should the day ever come when the love for the personalities of history is less and the desire for its instructive facts greater, those who occupy themselves in picking out the gold from the dross will perhaps be able to publish their results without inflicting on themselves losses too grievous to be borne—nay, may possibly receive some thanks for their pains."

Detractors have jeered at this work; but perhaps they may be interested to know that they were jeering at Aristotle. It is worth while to point out that the great Greek conceived and carried out a precisely similar plan. His Πολιτεῖαι contained a descriptive history of the constitutions, manners, and usages of one hundred and fifty-eight states. So that the method, though original to Spencer, was not new.

Finally, you may ask whether this conception of philosophy and this method of prosecuting it are sound. I will answer you in the words of the greatest thinker among English poets. Thus Wordsworth:

> "To the solid ground of Nature
> Trusts the mind which builds for aye."

Equally important and characteristic is Spencer's conception of religion. And by religion one, of course, does not mean any system or theory of morals. Religion is connected closely with morals in the modern mind, yet we know that long ages elapsed before any ethical element whatever entered into religion, and we further know that similar moral principles are common to the most diverse forms of religion. Granting that animism, fetichism, and the like, are not for our time, the question is whether there is any conception of religion which may show it to be necessary for man, quite apart from any ethical principles.

Curiously enough, Carlyle has so well expressed the Spencerian conception of religion that one cannot do better than quote him here:

> "Not the Church creed, which he professes—this is not what I call religion. But the thing a man does practically believe (and this is often without asserting it to himself, and less to others), the thing a man does practically lay to heart and know for certain concerning his vital relations to this mysterious universe, and his duty and destiny there—that is his religion; or, it may be, his mere scepticism and no religion."

To Carlyle, then, religion is man's conception of his relation to the mysterious—or unseen, or unknowable. This, it seems to me, is truer than Matthew Arnold's definition—"morality touched with emotion"—for morality is not of the essence of religion. Goethe, again, comes near Carlyle when he speaks of "the man to whom the universe reveals directly what relation it has to him."

Now the essence of Spencer's conception lies in the word *mystery*. Science, as we know, has done much to explain man's relation to the universe. If it had done *all*, there would be nothing left for the basis of a religion in Spencer's opinion. His contention is that it can never do all. "As knowledge cannot monopolise consciousness, it must always continue possible for the mind to dwell upon that which transcends knowledge. Hence there must always be a place for something of the nature of religion—which in all its forms is distinguished from everything else in that its subject matter is that which passes the sphere of experience." "If both religion and science," he goes on to say, "have bases in the reality of things, then between them there must be fundamental harmony. There can not be two orders of truth in absolute and everlasting opposition." This last sentence may be compared with the verdict recently passed, that it is hopeless to try to reconcile religion and science, "since they proceed from two different centres." For myself I find more satisfaction in the idea that there cannot be everlasting opposition between two orders of truth. The "vital element in all religions" is the conviction that there exists a *mystery;* to this science assents. If the two are to be reconciled, "the basis of reconciliation must be this deepest, widest, and most certain of all facts—that the Power which the universe manifests to us is utterly inscrutable."

This supreme verity is to Spencer the truly religious element of religion, and he goes on to urge that science has been, and is, the servant of religion, as the agent which purifies it of its irreligious elements—*i.e.*, of superstition.

Religion and science, in all their past stages, have rested content with superficial solutions, the conflict between them being the fault of imperfect development in both cases. Types of such superficial solutions are, on the one hand, the cosmology of the mediæval church, and, on the other, the materialism of more recent times. Each caused conflict, a true reconciliation being effected only by the common recognition on both sides of "the ultimate fact in our intelligence"—the knowledge that our knowledge is, absolutely considered, mere nescience.

This, then, is Spencer's conception of religion. Unlike Mr. Mallock, he seeks no refuge in a "practical synthesis of contradictories," nor is he content with an assertion that religion and science proceed "from different centres." How either of these notions can satisfy any one I cannot imagine. On the contrary, he finds the two orders of truth not absolutely irreconcilable, but merged in the ultimate fact in our intelligence.

He proceeded no further in this direction; but we may well consider his attitude towards religious beliefs which seemed to him untenable. He says that in order to attain the widest possible spirit of toleration, "we must recognise a fundamental verity under all forms of religion, however degraded, and must admit these various beliefs to be necessary parts of the constituted order of things."

This view has an intimate bearing upon practice. With that which is *absolutely* wrong there can be no compromise whatever. With that which is only relatively wrong the case is different. In his youth Spencer thought that one must oppose certain beliefs and that their destruction must necessarily be beneficial. But he gradually came to see that such beliefs are only relatively wrong, while his own cardinal principle of adaptation taught him that the relatively wrong may be relatively right for the society in which it is indigenous. At the end of his life he asserted that the alteration of belief which we know to be characteristic of our time may be proceeding at a rate inconsistent with safety. If the environment be too rapidly changed the organism will suffer. Who can doubt that the organism of French society is thus suffering for this very reason? This, then, is his conclusion—the more remarkable as reached by one in whom there was never any tendency to compromise:

> "Thus I have come more and more to look calmly upon forms of religious belief to which I had, in earlier days, a pronounced aversion. Holding that they are in the main naturally adapted to their respective peoples and times, it now seems to me well that they should severally live and work as long as the conditions permit, and, further, that sudden changes of religious institutions, as of political institutions, are certain to be followed by reactions.
>
> "If it be asked why, thinking thus, I have persevered

in setting forth views at variance with current creeds, my reply is the one elsewhere made. It is for each to utter that which he sincerely believes to be true, and, adding his unit of influence to all other units, leave the results to work themselves out."

Doubtless this conclusion will remind the reader of Spinoza, whose creed so closely resembled Spencer's. His landlady asked him whether he believed that she could be saved in the religion she professed. "Your religion is a good one," said Spinoza; "you need not look for another, nor doubt that you will be saved in it, provided that, while you apply yourself to piety, you live at the same time a peaceable and quiet life."

Tennyson has the same idea: "Leave thou thy sister when she prays." If you believed your sister's creed to be *absolutely* wrong, it would be immoral to follow this advice; but there is a "fundamental verity" in her creed, which your knowledge cannot overthrow, for "there cannot be two orders of truth in absolute and everlasting opposition." I wonder whether that saying thrills any reader's spine.

And as to the character of the man. The whole story is told in his remarkable *Autobiography*. Spencer tells us of his efforts to control his lack of tact, his lack of reticence, his hasty temper, his self-esteem, his indomitable but sometimes misdirected will. He shows us how even the finest intellect may err, in trying to give grounds for the belief that his father was his intellectual superior!

He compares his mother's great sacrifices for him with his small sacrifices for her, and speaks of the "unceasing regret" with which he recalls his lack of due appreciation of her when she was alive. In the "Reflections" with which the book closes we have a commingling of rare qualities; it is the most impressive and important chapter in the book, the last that humanity is to receive from one who wrought for half a century to give "more life and fuller" to the generations that are to be. To a cosmic range of intellect that enabled him to unify all knowledge in one inexpugnable generalisation, he added a love of humanity that made him the incessant foe of militarism, the champion of women and children, and the tireless seeker of such truth as might add to the dignity and worth of human existence in the coming stages of its evolution. Author of an idea which comprehends stars, atoms, societies, and thought itself within one principle, he yet found time to teach the medical profession that a child likes sweets because they are good for it, and the educationists that a girl's limbs are as much entitled to health-giving exercise as a boy's or a kitten's. Having established upon the basis of knowledge rather than fancy the truth that the Cosmos is an ordered unity, he yet insisted, in season and out of season, upon the claims of the individual as opposed to the many. Master of a wider range of knowledge, abstract and concrete, than any of his predecessors, he yielded to no one in his recognition that human knowledge is utter nescience; and amid the reviling of those who, in their prejudice and self-sufficiency, falsely called him "atheist" and "materialist," he taught, while conclusively proving that true religion must last as long as men continue to think, that we are "ever in presence of an infinite and eternal energy from which all things proceed."

Such was the man who has encountered more abuse and misrepresentation at the hands of his own countrymen than have fallen to the lot of thousands less courageous and original than he. Verily may it be said, in Emerson's phrase, of him whom "all the world outside the walls of our universities"—to quote the *Fortnightly*—honours and thanks to-day, that "to be great is to be misunderstood." But as I walked sadly away from the last scene, and saw a little film of smoke rise into the air from the crematorium tower, denoting the physical end of the great brain for which we are but the first of thousands of generations that shall yet give thanks, I comforted myself with old Daniel, "They that be wise shall shine as the brightness of the firmament, and they that turn many to righteousness as the stars for ever and ever."

THE IMPASSABLE BARRIER

THE thinker who does not recognise that there is, in the nature of the case, an impassable barrier to our obtaining any *ultimate* knowledge of the universe and ourselves will soon, unless he takes refuge in idealism, follow Haeckel and the other unscientific dogmatists who claim to have found the solutions to the "world-riddle." It is well, therefore, before venturing on any opinions as to ultimate facts, that we should do what these hasty reasoners have never done, and ask whether there be any necessary limitation to human knowledge, or, indeed, whether there be any possibility of human knowledge at all. The Greek sceptics said that science was impossible, and, in a sense, they were right. The modern "sceptic" of this school is entitled to the name only in so far as he doubts the dogmas of theology. Elsewhere this doubter will dogmatise with the loudest. For he knows neither his Locke nor his limitations.

When, more than two centuries ago, John Locke sanest and most pious of philosophers, proved—in his immortal *Essay Concerning the Human Understanding*—the non-existence of "innate ideas," he defined the impassable barrier. He showed that we have no ideas save what come by sensation and by reflection on previously gained sensations. *Nihil est in intellectu quod non prius fuerit in sensu:* Nothing is in the mind that was not first in the senses. To this Leibnitz, as we may remember, added "except the mind itself"—an obvious begging of the question which has nevertheless won the great admiration of the metaphysicians. Locke's proof of his assertion amounts to nothing less than demonstration, and undoubtedly constitutes him the father of that great branch of positive science which we call psychology. It has enabled us to rescue this ennobling and lofty study from the lifeless abysses of metaphysics, where its animation had for so long been suspended. Most earnestly do I recommend the reader to refer to that great masterpiece. But at this moment, if he has any recollections of his own childhood, he may remember how his own ideas of God or infinity have been evolved from childish conceptions founded upon experience. And study of the savage mind, since Locke's day, has further corroborated his contention. But let us look a little further at the assertion which must follow directly we admit the non-existence of innate ideas—the assertion, namely, that our knowledge must always fall short of ultimate reality.

Recognising that our eyes appreciate only a narrow portion of the compass of a certain type of ethereal waves; that our ears appreciate only a few octaves of those waves which, if audible, we term sound; that our sense of touch appreciates only the outsides of tangible things, and never the true inwardness even of these; that our senses of taste and smell appreciate only a few chemical compounds—we acknowledge at once that the *range* of sensation is limited. But the imperfection of our knowledge is far more evident if we consider the *nature* of sensation. It becomes necessary, therefore, to ask how valid a sensory impression is and in what it really consists.

The essence of all our ideas and of all our knowledge is to be found in changes in our own consciousness. When I see this paper I am aware of a change in my consciousness—a change in myself—and no more. Bishop Berkeley, therefore, argued, in his system of idealism, that there is no such thing as matter or substance, in the ordinary sense; that material things have no objective existence, no existence outside ourselves; and that the external world, which other people postulate as the substance (or "thing standing under"), the attributes which we recognise, is a figment of the imagination. We put together certain attributes—as form, colour, and tangibility—and the result of our synthesis we call matter. Berkeley said that the synthesis was mental, and mental only.

Now, let us be perfectly frank and fair about Berkeley's complete and final idealism. He has never yet been answered—I am fully aware that Spencer has *nearly* succeeded—and, as far as we can see, he never will be. As Hume says, his arguments "admit of no answer and produce no conviction." Other idealists of sorts, such as Kant, are vulnerable and have been proved so, but Berkeley is practically immune from all assaults. It is admitted, even by his opponents, that he is the most difficult of all philosophers to refute. As for Dr. Samuel Johnson, who thought he had disposed of Berkeley by kicking a stone, he only demonstrated thereby his congenital incapacity to understand even an elementary philosophical conception. Nevertheless, the universal belief of mankind is against Berkeley, and, not counting the academic philosophers—who really do not count—we may say that not one man in many millions at the present day denies the existence of *a something* outside himself. In other words, we are all realists to-day. We believe in objective reality, some of us holding that we *know* it; others—and these the wisest and greatest—that we do not and cannot truly know it. As for the various forms of compromising idealism which Germany has given to the world since Berkeley's day, they have been all but abandoned in the land of their birth—thriving only in places indicated by the saying that "good German philosophies, when they die, go to Oxford"—and now that the wonderful German mind has left word-jugglery and metaphysics for positive science, in which it leads the world, it is surely high time that the sterile and empty subtleties which have made no one better or wiser or happier, have averted no moment of agony, have illumined to none the valley of the shadow of death, have slain no tyrant, have abolished no abuse, have added no iota to the world's air or light or beauty or life or love, should be left aside until the *Weltschmerz* is no more.

Abandoning idealism, then, and admitting that the Cosmos is something more than "such stuff as dreams are made of," we must face the consequences of our recognition of the fact that all our knowledge is only relative. Classing ourselves, then—despite the prevailing fashion in academic philosophy, which just now happens to be idealism—as realists, and asserting, for instance, that something corresponding to what we call *matter* really exists—we must consider what we really know of it. We know it, then, only by its appearances or its attributes. Ultimate reality we can never know, for we are only aware of the changes which its attributes produce in our consciousness. Our knowledge is only of phenomena or appearances. Absolute truth is unattainable by us; there can never be such a thing as a science of being, but only a science of appearances, only of *phenomenal* knowledge. The recognised modern synonym for metaphysics is ontology, which is literally the *science of being*, and ontologists differ from scientists in this, that every one of them successfully refutes every other. After two thousand years and more of unredeemed failure, we may therefore fairly say that there cannot be a science of being—especially since we can now explain the failure.

Against certain fallacies of the crude realism of the cow-boy or illiterate, who fancies that things are really what they seem, we can be on our guard. Knowing that, in the ultimate analysis, all our knowledge comes through our senses, we also know that the untrustworthy evidence of these senses needs the constant criticism of reason and experience. If I were to see a "ghost," I should mutter "hallucination." If I saw a delirious patient catching at an imaginary insect in the air, I should not rub my eyes because I could not see that insect. Again we can forestall the fallacy that what is not appreciable to our senses is therefore non-existent. The Quaker had a pertinent retort for the young fool who said he believed in nothing he could not see. "How dost thou know thou hast a brain?" But, however rigidly supervised, the evidence of our senses informs us only of the attributes of things, never of the nature of the power of which they are the manifestations.

We will do well, then, to be humble. Recently the greatest of living scientists, Lord Kelvin, affirmed that science proves the existence of God. Haeckel says that science proves the non-existence of God. Neither assertion is postulated from absolute knowledge. Haeckel and his followers assume, first, that Berkeley is wrong, and that matter really exists. This assumption they can only make, if at all, by asserting that our knowledge is relative, not absolute, though, as a matter of fact, they do not appear ever to have heard of Berkeley. Thereupon they abandon this view of the relativity of knowledge—upon which they insist when it suits them—assume that their tiny perceptions of phenomena have positive and absolute truth, and assert that we know, essentially, all that there is to be known. Wilhelm Wundt, of Leipsic, the first of contemporary psychologists, has said that we would do better, if we cannot turn psychological research to practical account, to devote ourselves to the improvement of sewing-machines. Now this is just one of the instances where psychology can be turned to practical account. If the materialists cared to acquaint themselves with this most important branch of the positive science which they so belaud, they would learn that all the knowledge of the cleverest of them is derived from certain changes in his consciousness, for he was born, like the rest of us, without an idea in his head, and has since acquired nothing more than certain partial recognitions of certain attributes of a "substance" of which he asserts that it is "self-existent" (whatever that means) without having any proof that it exists at all. He can assert as positive actuality only his recognition of his own consciousness: "*cogito; ergo sum*," as Descartes has it.

Science is only a science of phenomena, as I have already asserted. Metaphysics, ontology, or a science of *noumena*, as distinguished from phenomena, is impossible, because we can never transcend the sphere of our own consciousness; and since we are born without ideas, and since our senses inform us only of appearances or properties or phenomena, further than mere science or phenomenal knowledge the human intellect can never go. The materialist denies the existence of innate ideas; but not seeing that this denial is also a denial of the possibility of any knowledge of ultimate reality, he is quite prepared to frame dogmatic assertions as to ultimate reality—though he has not even attempted to notice, still less to refute, the Berkeleian argument that the Cosmos is but the "content of consciousness" and has no objective reality. That assertion cannot be disproved, however absurd it may appear to the "philosophy of common-sense."

In "positive science," so called, is therefore to be found no key to the world-riddle. No one admires science more than I do. I find in her not merely a source of intellectual interest, but a force making for individual and general happiness. But I recognise the basis on which she rests and to which she is confined. Ultimate questions can never receive from her a positive answer, an answer positive in the sense that two and two are positively four. As a critic and criterion of supposed philosophies, science is invaluable; as a basis for an ontology, or knowledge of reality, science is worthless. Phenomenal knowledge cannot transcend phenomena; and how can an ultimate philosophy be based upon a mere seeming? Since the multiplication by infinity of our infinitesimal knowledge of phenomena would bring us no whit nearer the noumenon or reality which, unless we are idealists, we are bound to postulate; since man can never *know* more than changes in his own consciousness, we may sing pæans to science, and believe in our hearts as we see with our eyes that she is truth and will prevail against ignorance and evil, its unseemly spawn; but as to her power to solve ultimate questions, a power which has ever been disclaimed by the greatest of her prophets, we would do well to preserve a decent humility withal.

Ultimate questions can be answered for each only, if at all, by the faith of each. And if you ask me what business I have to talk of faith, I answer that science is built upon faith. Even Haeckel's dogmas are built upon faith—faith that what he sees exists, and that he sees all that there is to see; faith that his data are absolute and his logic sound.

And, similarly, the justifiable dogmas of science are built upon faith. Take a great induction like the law of gravitation. It asserts that every body in the universe attracts every other body with a force which varies directly as the mass and inversely as the square of the distance. But Newton had not tested every body in the universe: nor have we. We believe that the law obtains everywhere. So if Dr. A. R. Wallace, in support of his reassertion of the Ptolemaic or geocentric cosmogony, which makes our earth the centre of a supposed finite universe, cares to suggest, as he does, that at the supposed confines of the universe the law of gravitation will probably not hold, and that consequently life could not be developed there—well, we cannot contradict him. He has no facts in his favor, it is true, but our assertion of the universal applicability of Newton's law depends on faith, which Dr. Wallace need not share unless he likes. We who are not committed to untenable hypotheses have one fundamental article of faith—for it is no more—from which we always argue. We cannot prove it or disprove it, but we believe it. It is that causation is universal. When Hume and Kant have had their say, it resolves itself into a question of faith. I cannot prove to you that causation exists on the moon. I can only argue that effect has always followed cause in my experience, and so I make the induction that causation is universal. But it is only a belief. Science is a splendid edifice, but it has only the imperfect evidence of our senses—changes in our own consciousness, that is to say—on which to rest, and upon these we can build only by faith. Each of us has his own philosophy, therefore: nor do we question your right to yours. And there are more things in heaven and earth than are dreamed of in the philosophy of any of us—can you doubt?

THE LIVING GARMENT OF GOD

We shall get as near as possible, I fancy, to the materialist conception of the Cosmos by saying that it consists of two entities, matter and motion, which are constantly undergoing redistribution. The motion is regarded, at any rate by some, as a mere function of the matter, which is supposed to consist of small, hard, rounded atoms, something like very small grains of sand. More latterly, a materialist of a less unscientific school, the notorious Haeckel, of Jena, has given something more of its real importance to the motion or energy which is always associated with matter. He conceives of two inseparable entities, matter and energy, which constitute the sum of all things. This admission of the existence of energy does not constitute him any the less a materialist, despite his quibble that energy is spirit. Now what has contemporary science to say to this creed?

It is refuted by two sciences wellnigh as different as they can be—physics and psychology. First let us consider the judgment of physics. The small, hard, indivisible atom has totally disappeared as a tenable conception. This disappearance, curiously enough, is a blow alike to the materialists, who regarded the atom as the ultimate reality, and to many of their opponents, who regarded it as bearing the stamp of the "manufactured article"—to quote the phrase of a celebrated physicist of time past. But from henceforth the materialist and the supporter of the orthodox idea of "creation" must find other support than any to be derived from the atom. I need hardly reiterate here our present knowledge of the atom. It will be remembered that radium and radio-activity have shown atoms to consist of a large number of corpuscles or "electrons," which move within the atom as the planets in a solar system. But what is an electron? Is *it* a small, hard, rounded, indivisible body, to which the name of atom should etymologically belong? Not at all, unfortunately for the materialists. The physicists have weighed the electron—which is apparently an invariable entity in all forms of matter—have measured its velocity, and have defined its properties. All its properties are electric. At first they said, "It *carries* a charge of electricity." Then they found that its weight—*i.e.*, its inertia—is electric, and so they had to say, "It *is* a charge of electricity." Modify this a little further and observe the significant conclusion. An electron is a unit charge of electricity. Why not then call it, as Sir Oliver Lodge suggests, an atom of electricity? But electricity is not a material thing, but a form of energy. So an electron is *an atom of energy*, and we have resolved all matter into a congeries of atoms of energy. Plainly, therefore, the term "materialism" is out of date; but all the quondam materialist has to do is to say, "Very well, it doesn't affect my position, which simply becomes one of 'energism.' I will call myself an 'energist.' My creed is that the Cosmos consists of energy."

Obviously it was not worth while to write this essay if that was the only conclusion—simply that matter had now been resolved into a form of energy, and that the term materialism could no longer hold. Spencer resolved matter into a manifestation of energy in *First Principles* forty-four years ago, and it was hardly worth while to devote an article to showing that within the last lustrum the physicists have experimentally demonstrated the truth of his reasoning. In the sense that we must refer all phenomena to energy we are all energists nowadays; but let us observe that our position is *toto coelo* different from that of the materialists. Let us inquire into the value of our pretty verbal counters. We have resolved everything into energy, but what is energy? . . . Don't hurry on to the next paragraph. Make up your mind quite clearly and positively. First get a definite, intelligible answer to the question—if you can.

Of course you cannot. All we can do is to conceive of a non-material *something* which possesses power. Contemporary physics has simply resolved the Cosmos into a manifestation of power. We can name certain of its attributes, we believe, that of imperishableness being the chief. But assuredly we cannot *know* it, nor explain its existence. Nor have we yet made any reference to the entity called *mind*, to which the existence of this eternal power has been revealed, and which is itself a manifestation of the eternal, mind and matter being, to Spencer as to Spinoza, the opposite and correlative manifestations of the one supreme reality.

Now what has psychology to say? Psychology has disposed of the old theory of "innate ideas." Locke did that for us, but Kant regarded time and space as the *a priori* forms of thought. Oxford and Cambridge still swear by Kant, of course, but modern psychology—if, indeed, I should not say physiology—has analysed our perceptions of time and space, and can tell us how they are formed in our consciousness. The dogma of "innate ideas" having been proved false, we have to recognise that all we know are states of consciousness derived, as not even the idealist questions in his heart of hearts, from our sensory impressions of the external world. Are we, then, to content ourselves with the "naïve realism of common-sense"? Assuredly not. Only the child and the unreflecting imagine that the external world is anything like our sense-pictures of it. Conceive the fibres of the auditory nerve running to the visual centres, and those of the optic nerve running to the auditory centre, so that you see the music and hear the conductor conduct. What sort of an external world is it then? We know nothing but phenomena or appearances.

The noumenon or ultimate reality we can never know. All philosophy converges upon this truth. Physics has resolved all things into energy. But you have tried to conceive energy and have failed. Psychology tells us that all we know are states of consciousness which tell us of phenomena, and phenomena are the attributes of energy, whereby we know that it exists, but know it-in-itself we never can. It is the unknowable of Spencer, who taught that we are "ever in presence of an infinite and eternal energy, from which all things proceed."

Science, then, gives us, indeed, a mechanical universe and an absolute determinism; but an enlightened science, knowing psychology as well as physics, teaches that this mechanical universe is but the phenomenon, behind which there is a noumenon "from which all things proceed."

Herbert Spencer's doctrine of the unknowable provided him with a reconciliation between religion and science. He asserted, indeed, that there never can be any antagonism between religion and science, but only between superstition and science. True science and true religion must meet, he said, in the recognition of that infinite power of which mind and matter are the manifestations to us. There he left the matter, save for one sublime thought—the greatest ever conceived by that great mind. The choice is not, he said, between a personal God and something lower, but between a personal God and *something higher*. The Eternal may be "a mode of being as much transcending intelligence and will as these transcend mechanical motion." This, verily, is the "higher pantheism." Mr. Picton, building on this foundation, in his book, *The Religion of the Universe*, has given us a really ennobling and magnificent conception of this supreme creed. No one but the child now believes in the Artificer-God who is outside the universe. We may remember that the model of the universe conceived by the celebrated Robert Boyle was the Strasburg clock with an outside artificer; but we have learned to reject this view to-day. As George Meredith says, "The God of this world is in the machine, not out of it." Nearly thirty years ago Tyndall pointed out the superiority of Carlyle's conception of the universe to that of Boyle. The great Scot regarded the Cosmos as a tree—the life-tree Igdrasil.[1] The difference is evident. A machine is an organism having life and direction without; a tree is an organism having life and direction within.

The Catholic theologians have often taught us to conceive of a God immanent in the universe—only, unfortunately, they cannot consistently keep up to the level of this conception. The believer in a personal God has very rarely, if ever, inquired into the meaning of personality. If he did, he might find that the attribution of personality to the Eternal is hardly less gross a piece of anthropomorphism than a thousand others of the past. Yet

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[1] *Past and Present.*